#WWDC19

Low-Latency HTTP Live Streaming

Roger Pantos, HLS Technical Lead

Why lower latency?

Crucial for Some Content

Crucial for Some Content

Sports

Crucial for Some Content

Sports

Late-breaking news

Crucial for Some Content

Sports

Late-breaking news

Real-time interactive gaming broadcasts

Crucial for Some Content

Sports

Late-breaking news

Real-time interactive gaming broadcasts

Award ceremonies and other social media events

How Low?

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2-8 seconds matches cable satellite TV

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Designing for 1-2 delay (at scale!)

It’s Still HLS

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Rate adaptation

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Rate adaptation

Encryption, ads, metadata

It’s Still HLS

Rate adaptation

Encryption, ads, metadata

Scales with regular CDNs

It’s Still HLS

Rate adaptation

Encryption, ads, metadata

Scales with regular CDNs

Backward-compatible

How To Do It

Regular HLS Latency

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HLS was designed to be simple and robust

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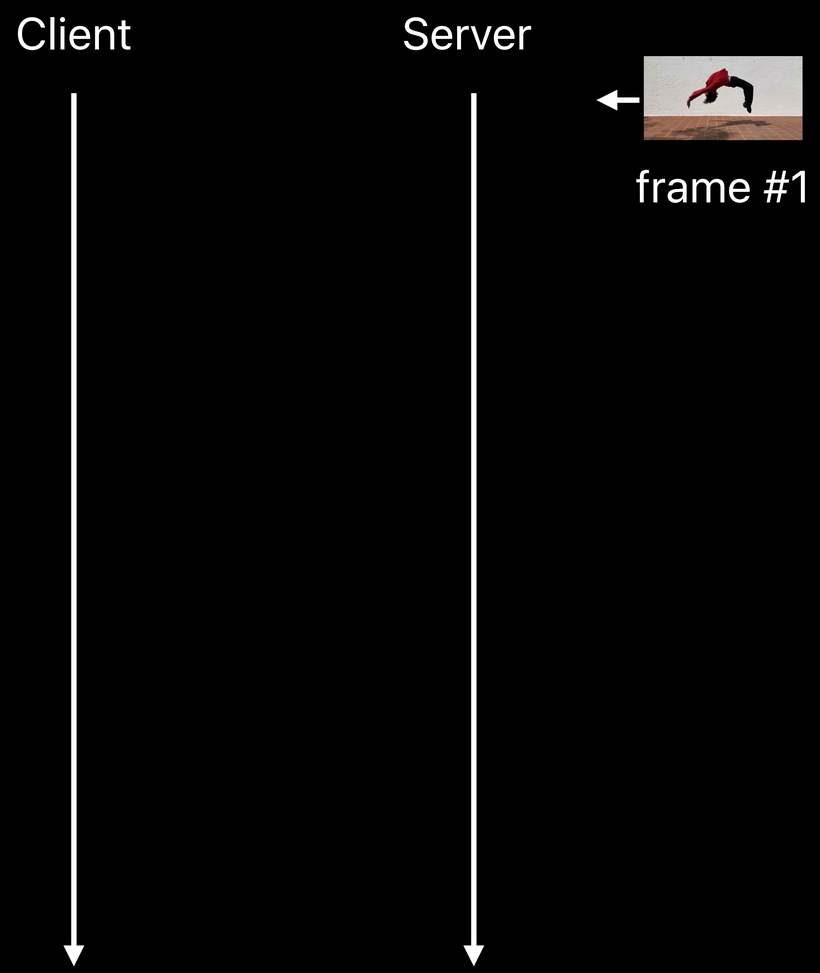
But simplicity has a cost

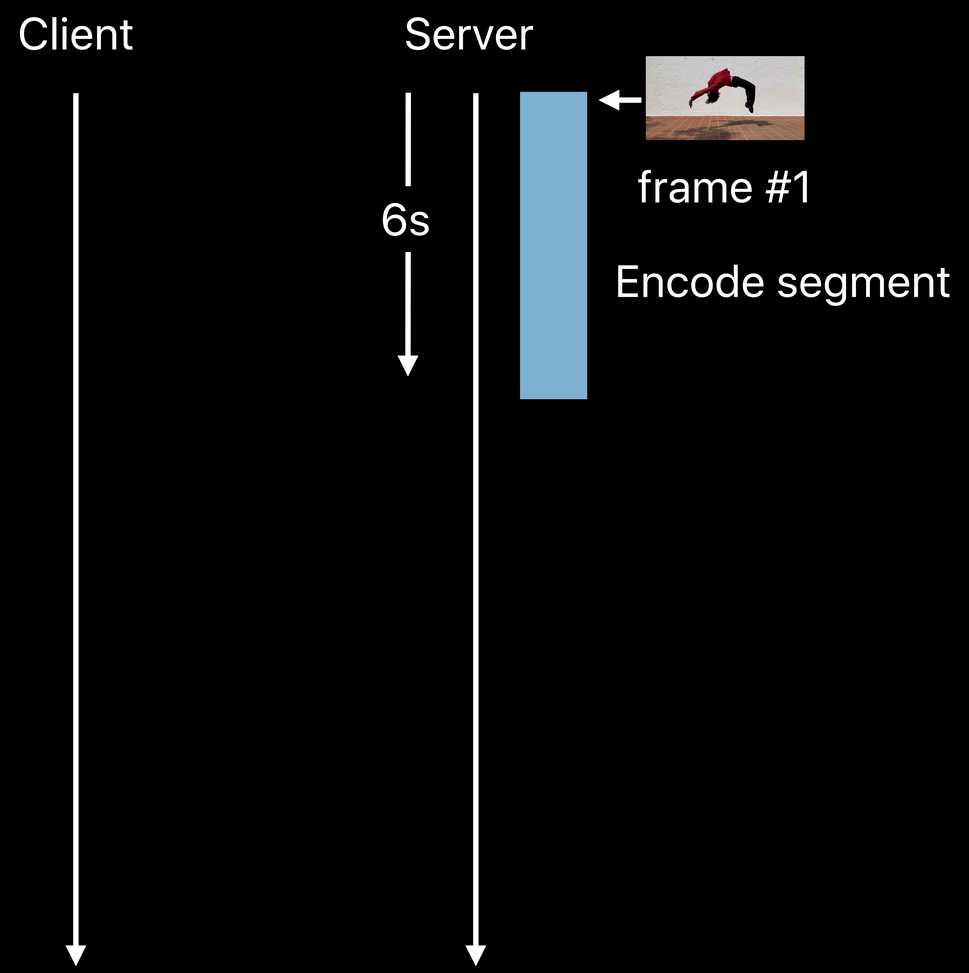
Regular HLS Latency

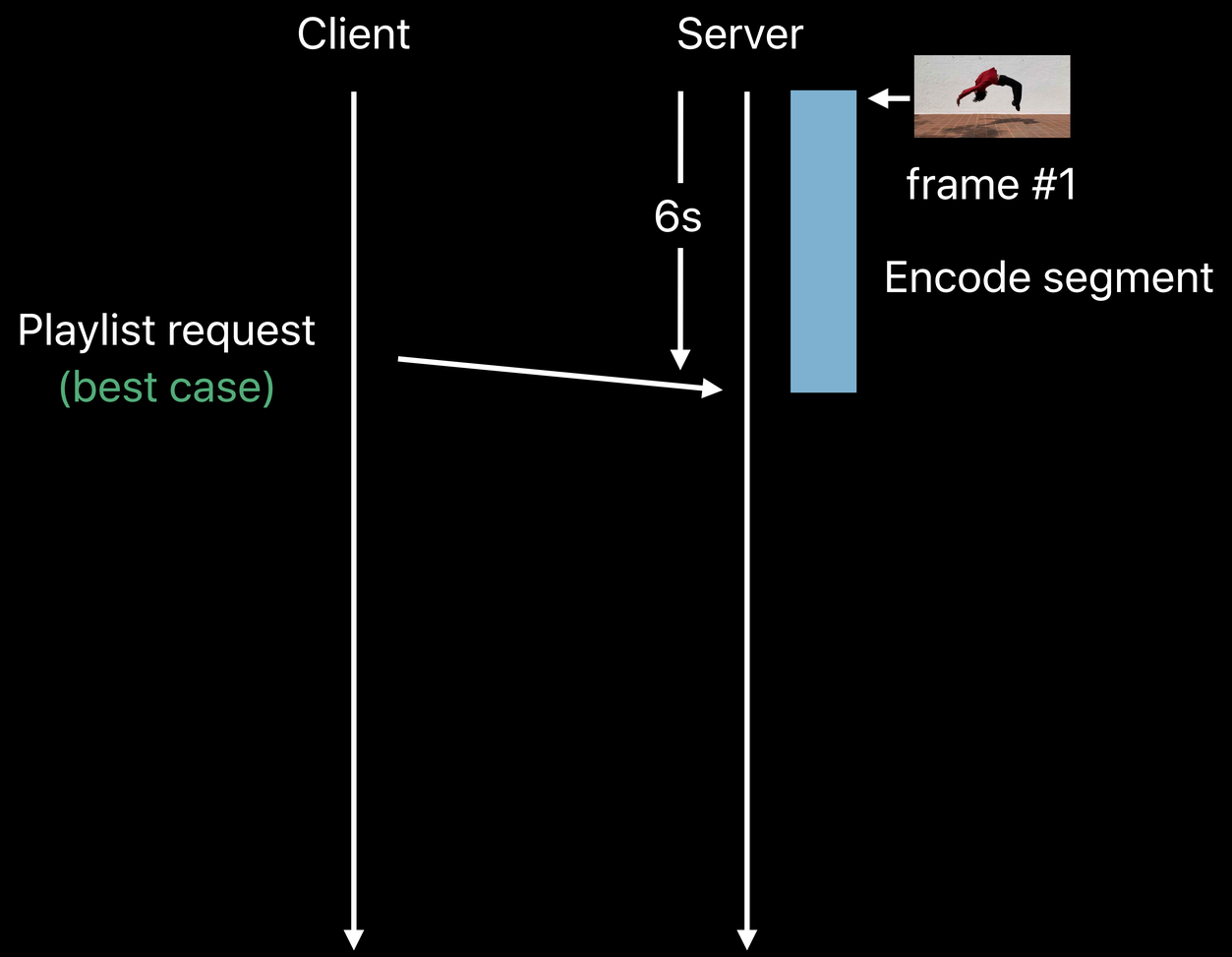
HLS was designed to be simple and robust

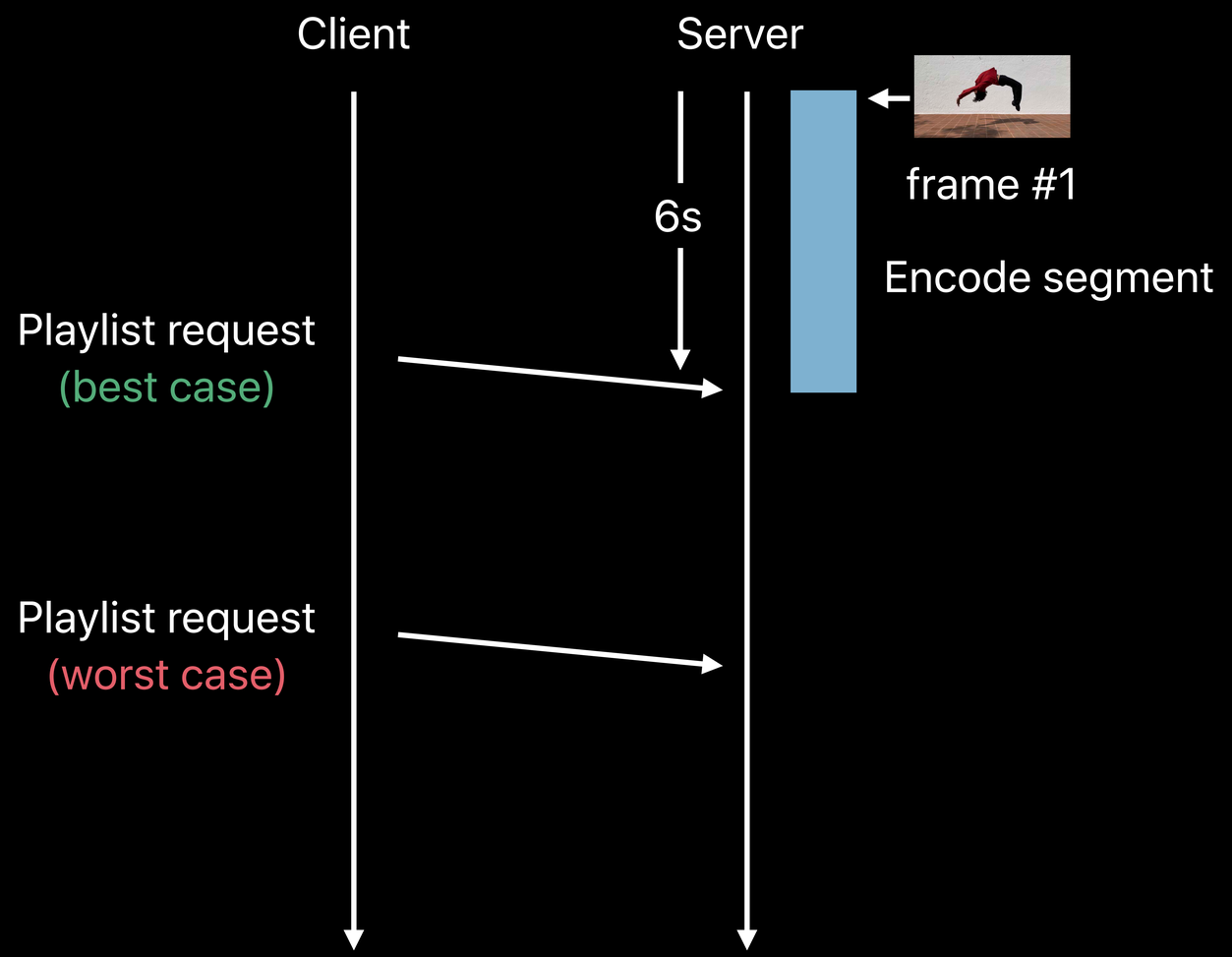
But simplicity has a cost

HLS typically lags 20-30s behind live


Client
Server
frame #1


Client
Server
6s
frame #1
Encode segment


Client
Server
frame #1
6s
Encode segment
Playlist request
(best case)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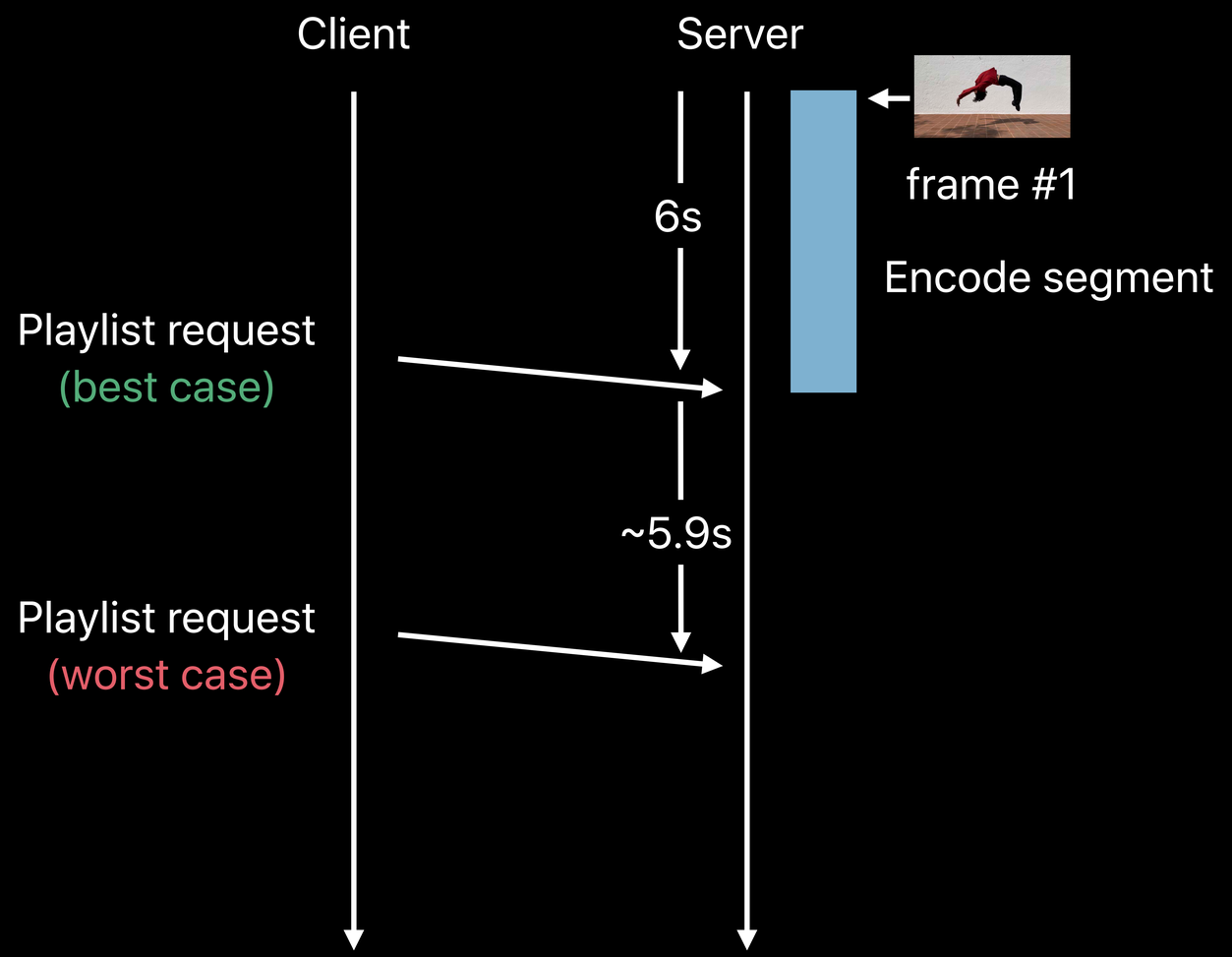
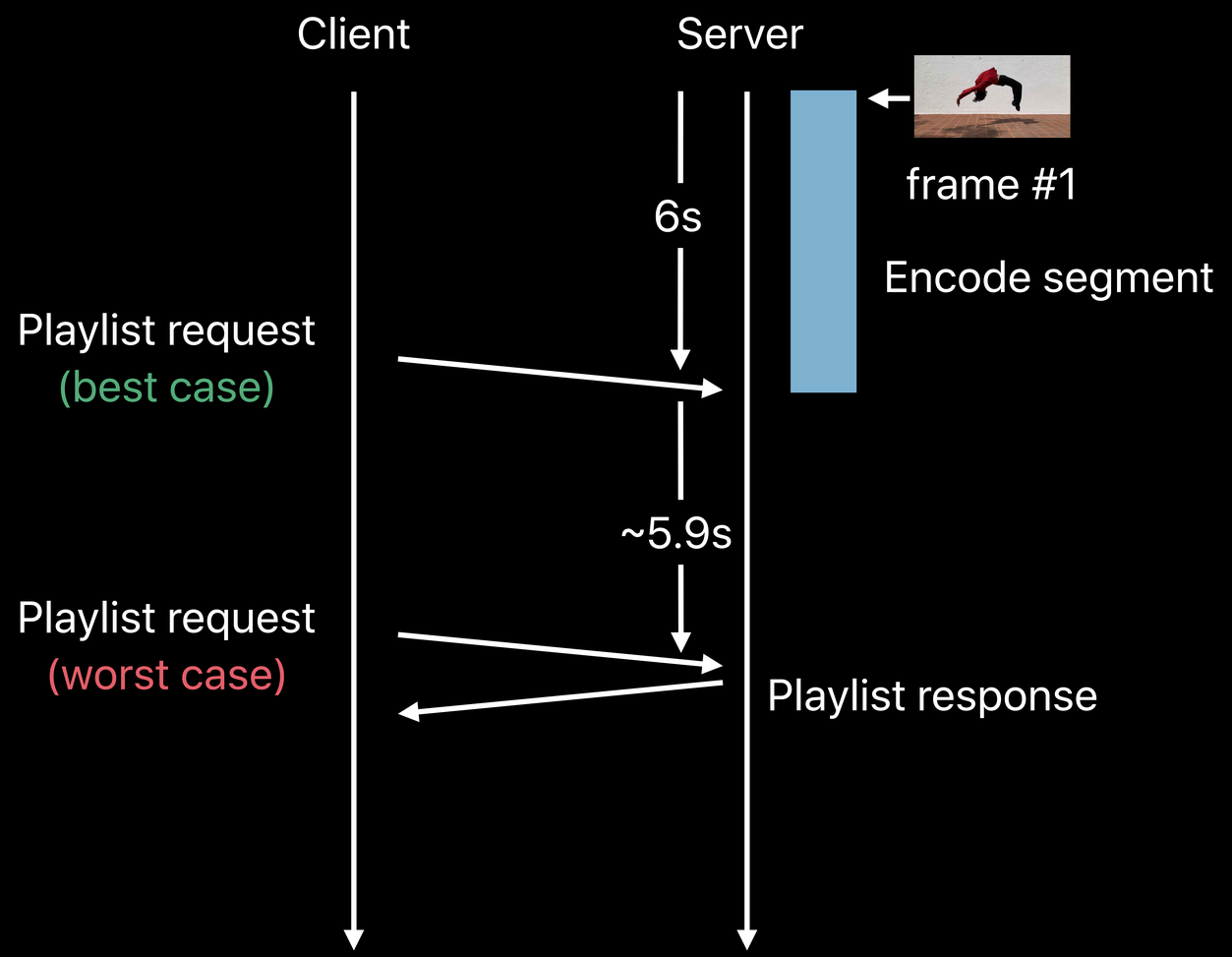
Encode segment
Playlist request
(best case)
Playlist request
(worst case)


Client
Server
frame #1
6s
Encode segment
Playlist request
(best case)
~5.9s
Playlist request
(worst case)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Playlist request
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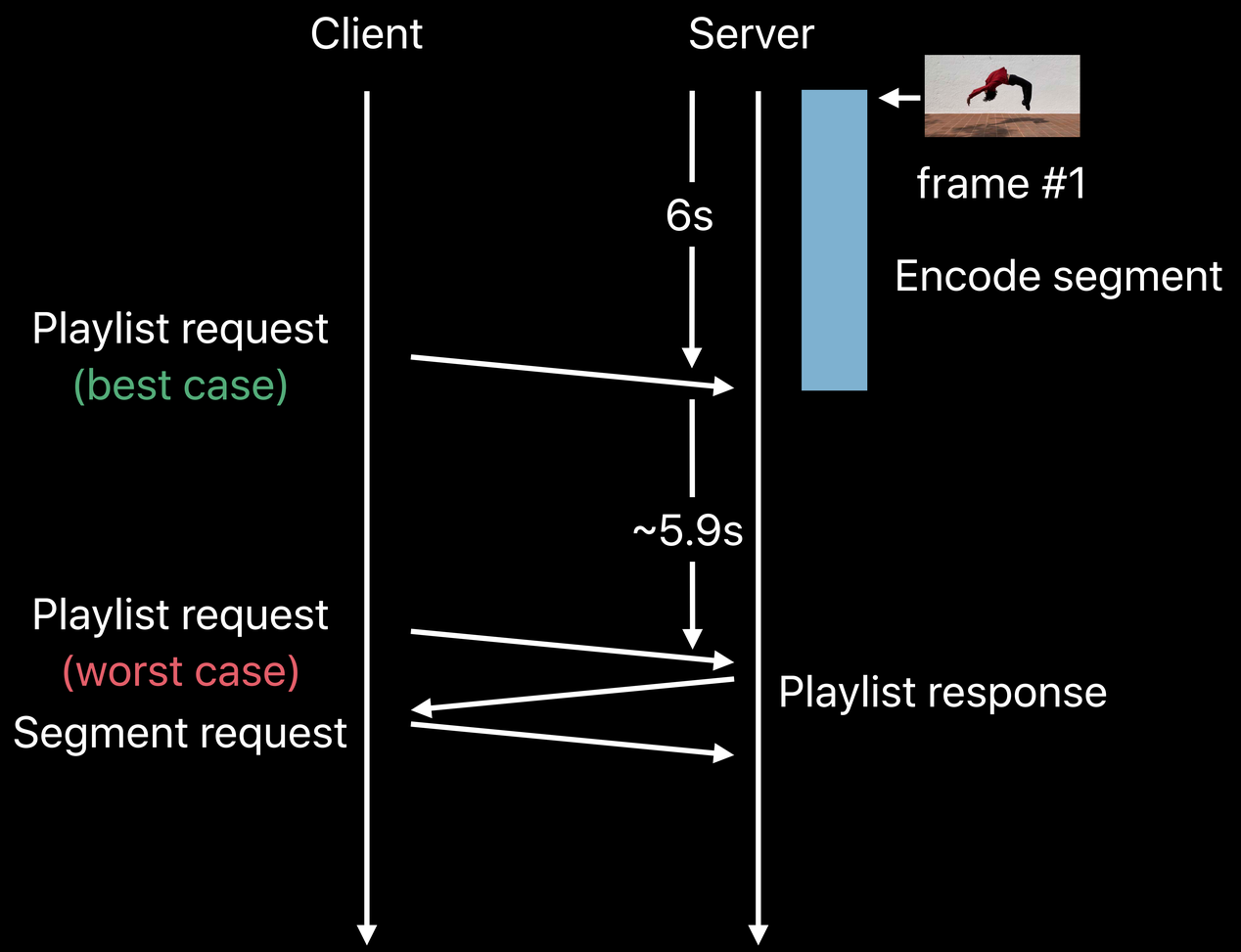
Playlist response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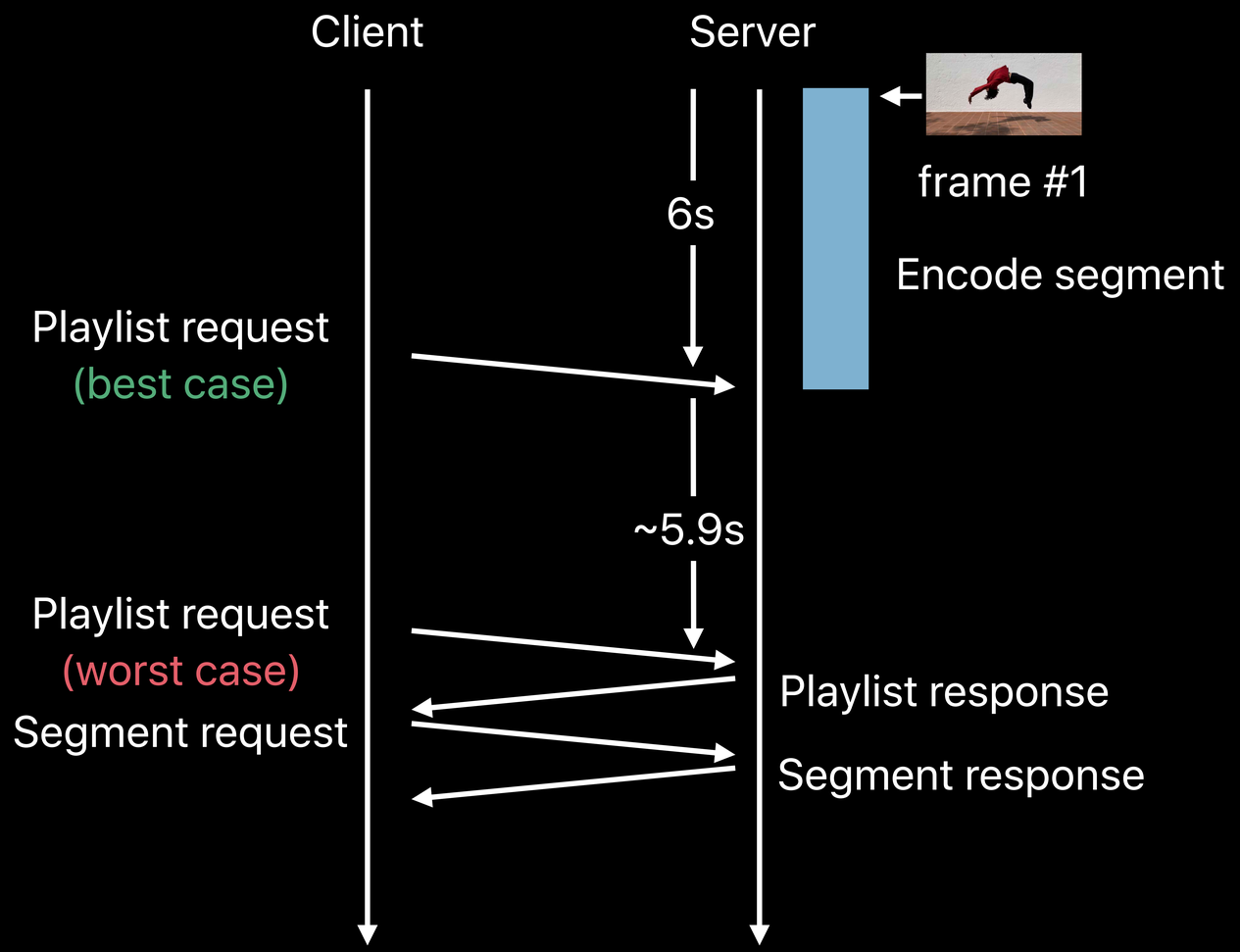
Segment request
Playlist response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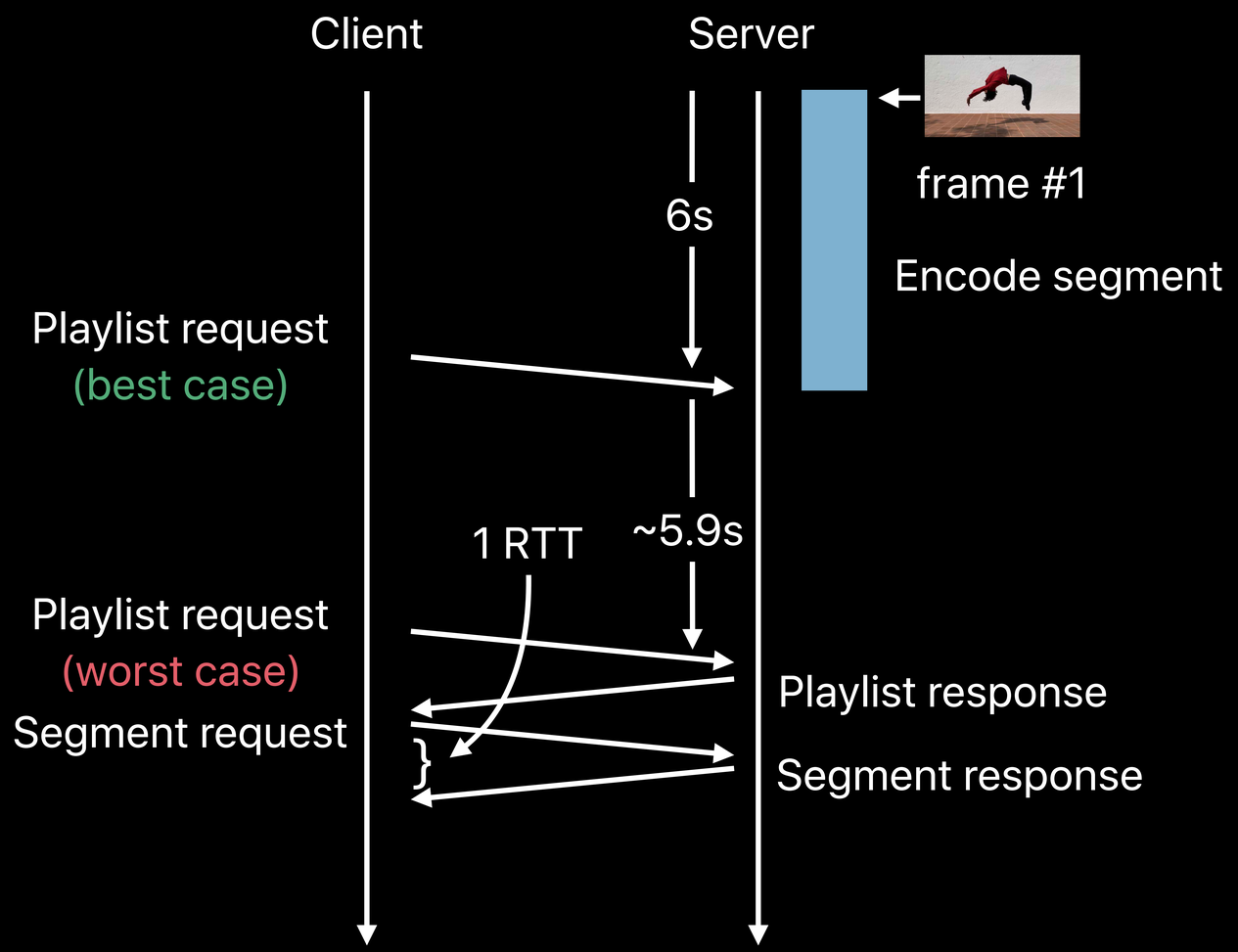
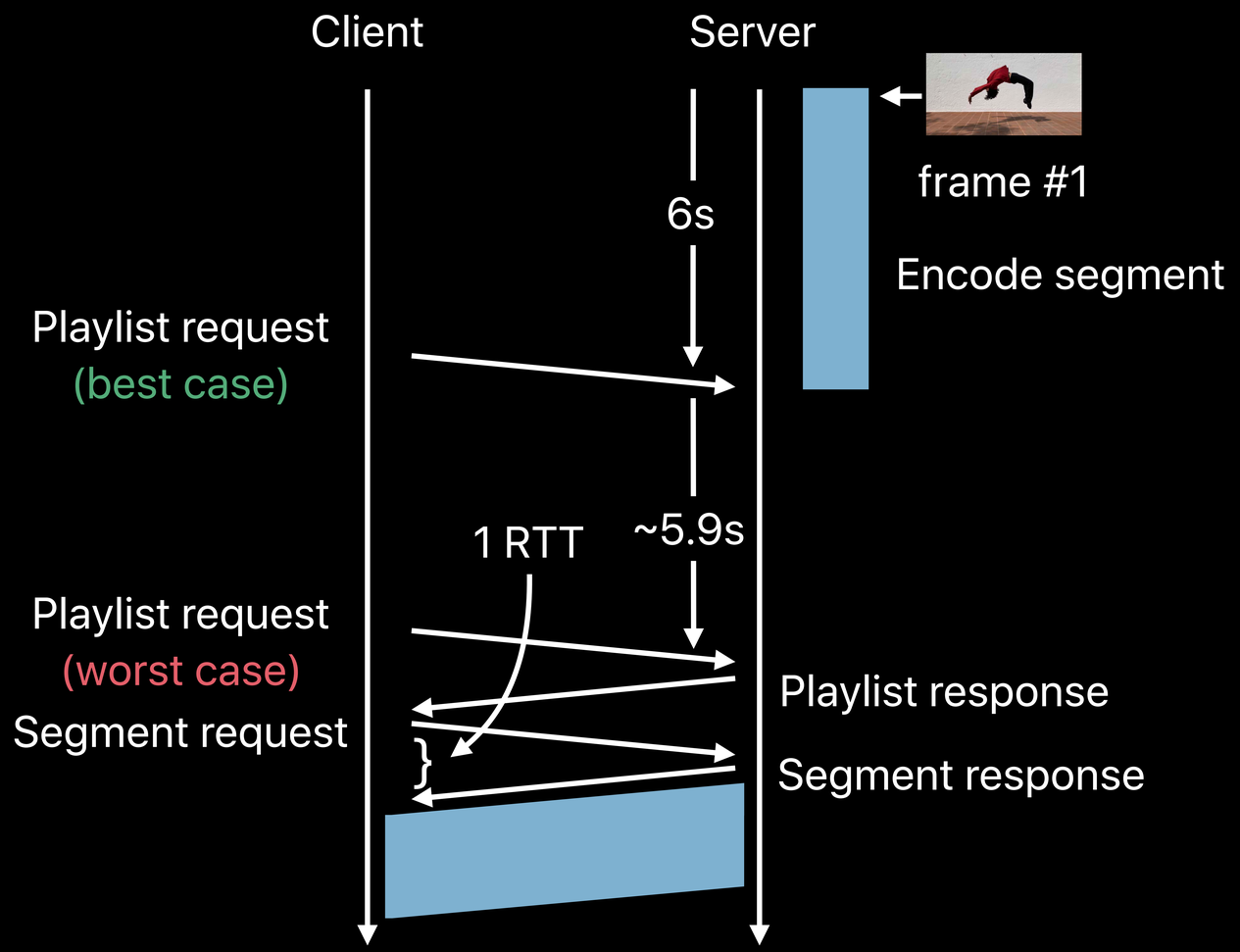

Client
Server
frame #1
6s
Encode segment
Playlist request
(best case)
1 RTT
~5.9s
Playlist request
(worst case)
Segment request
Playlist response
Segment response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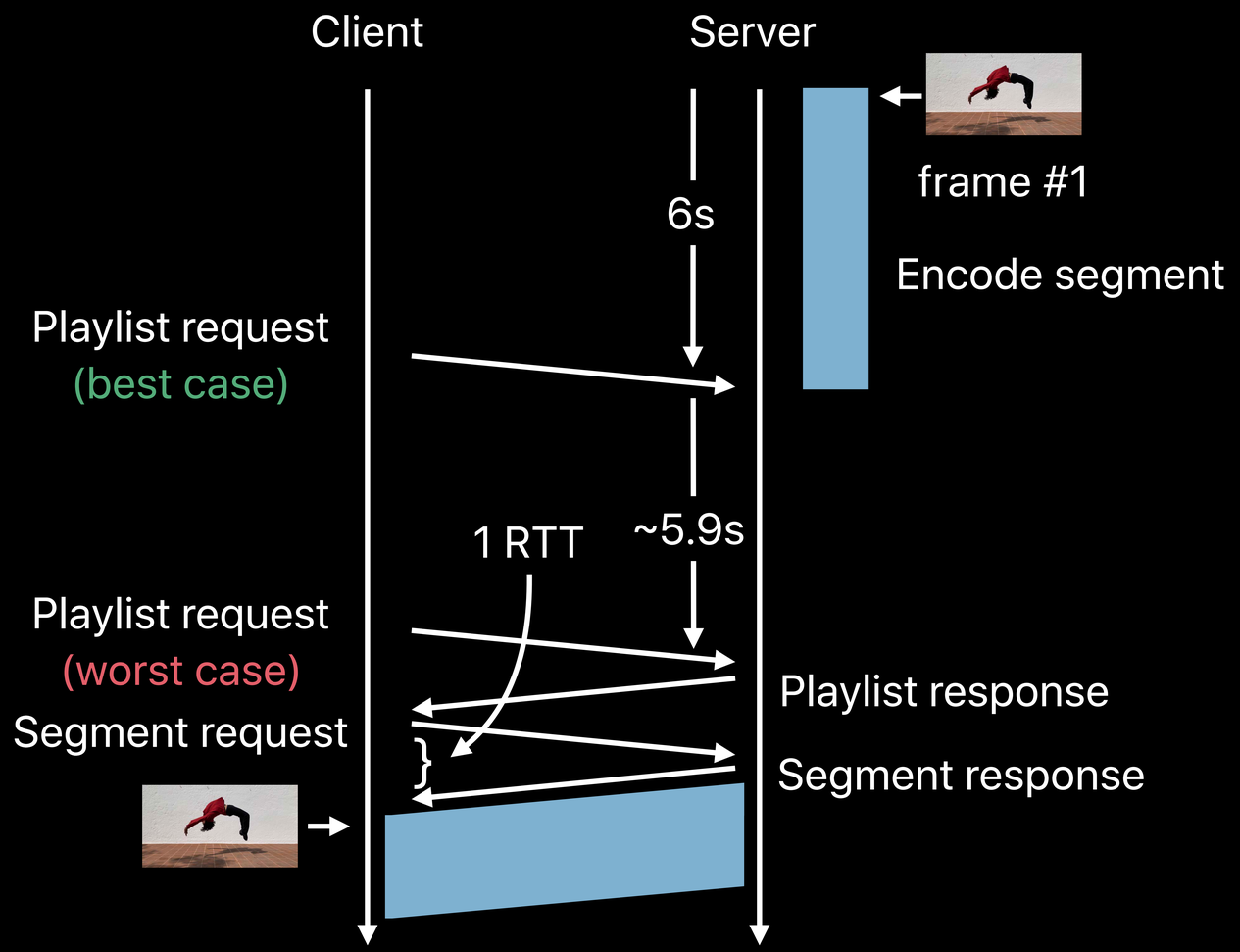
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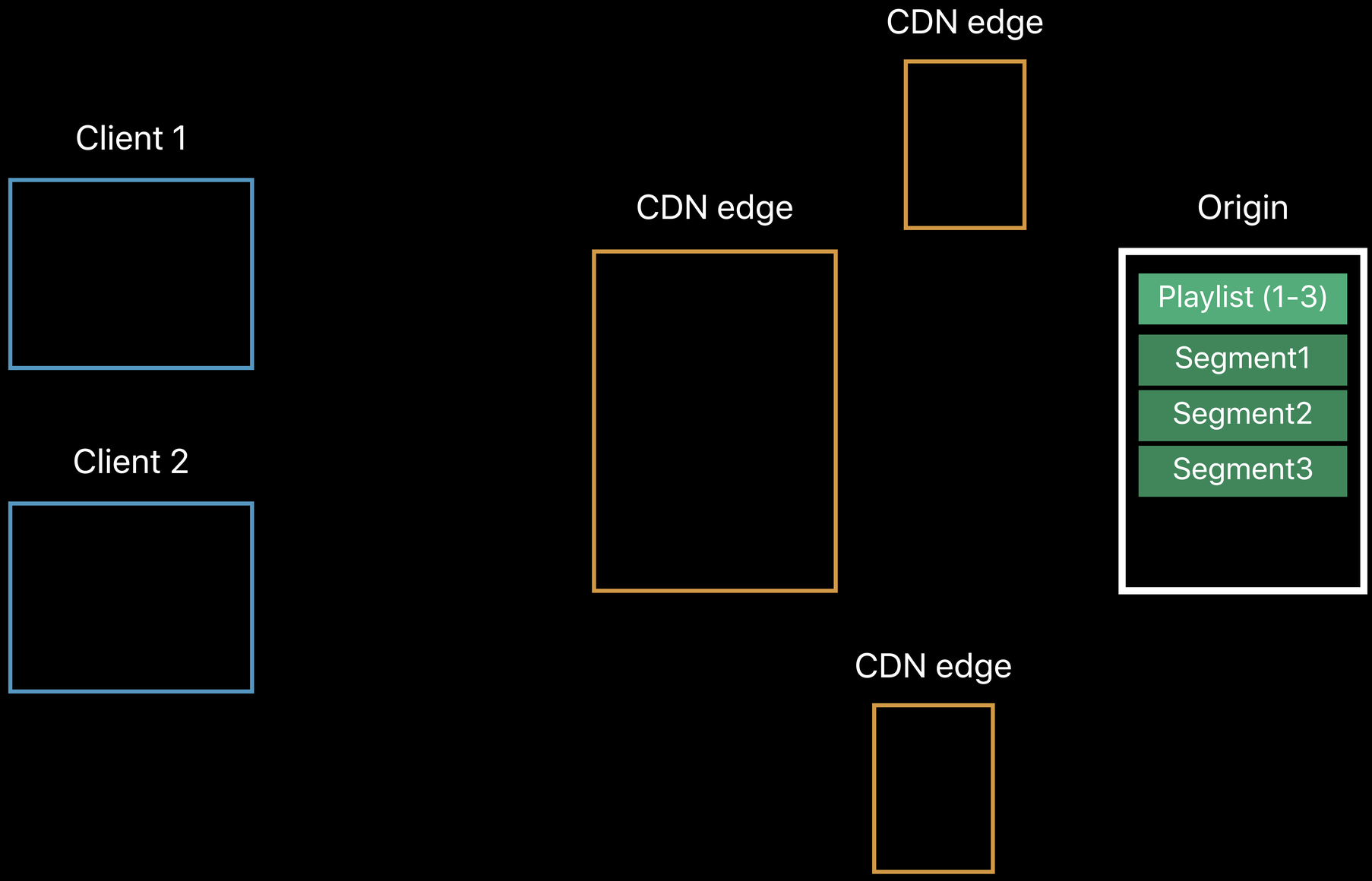
Segment response

Too Much Caching Hurts Latency



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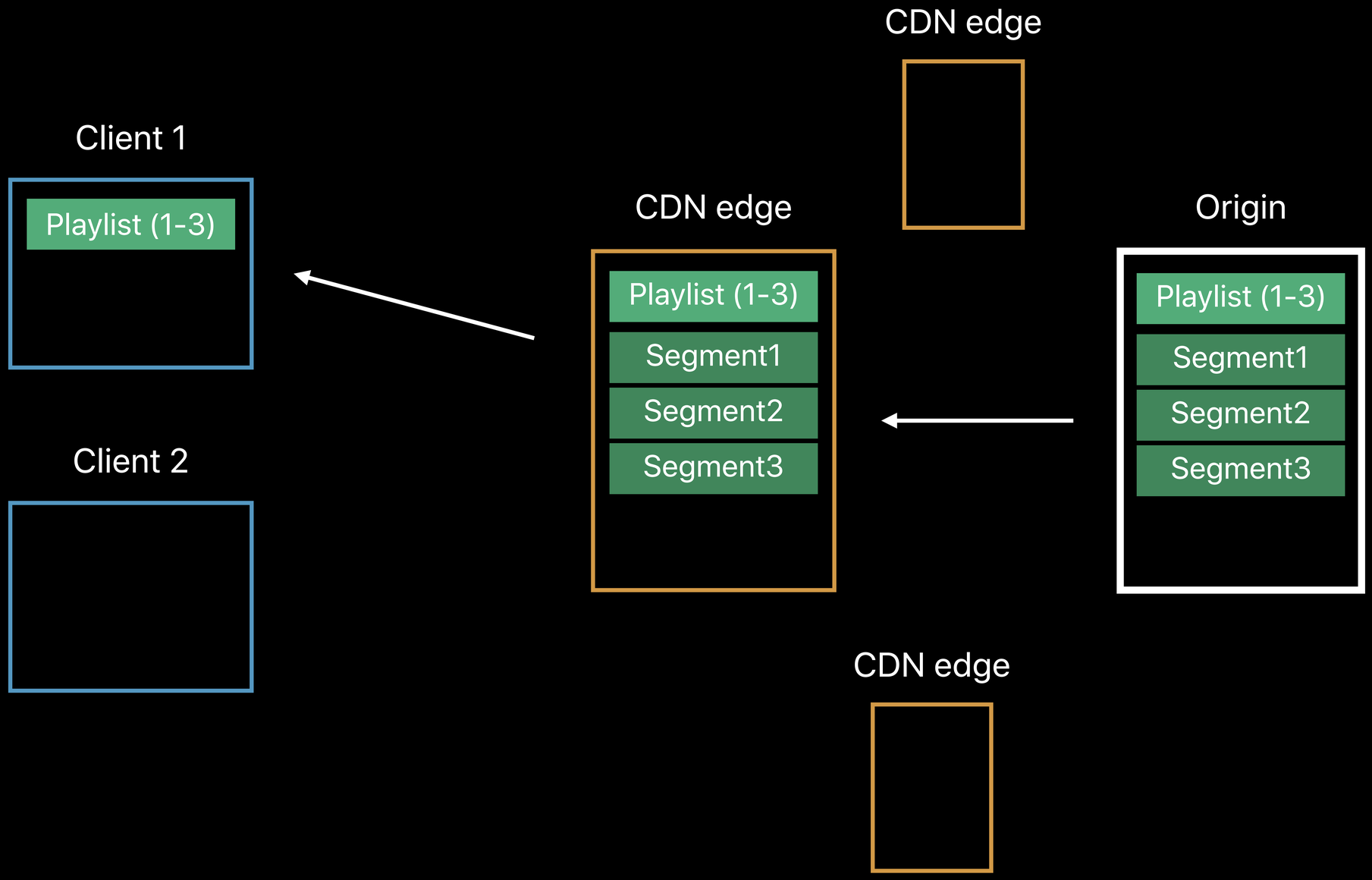

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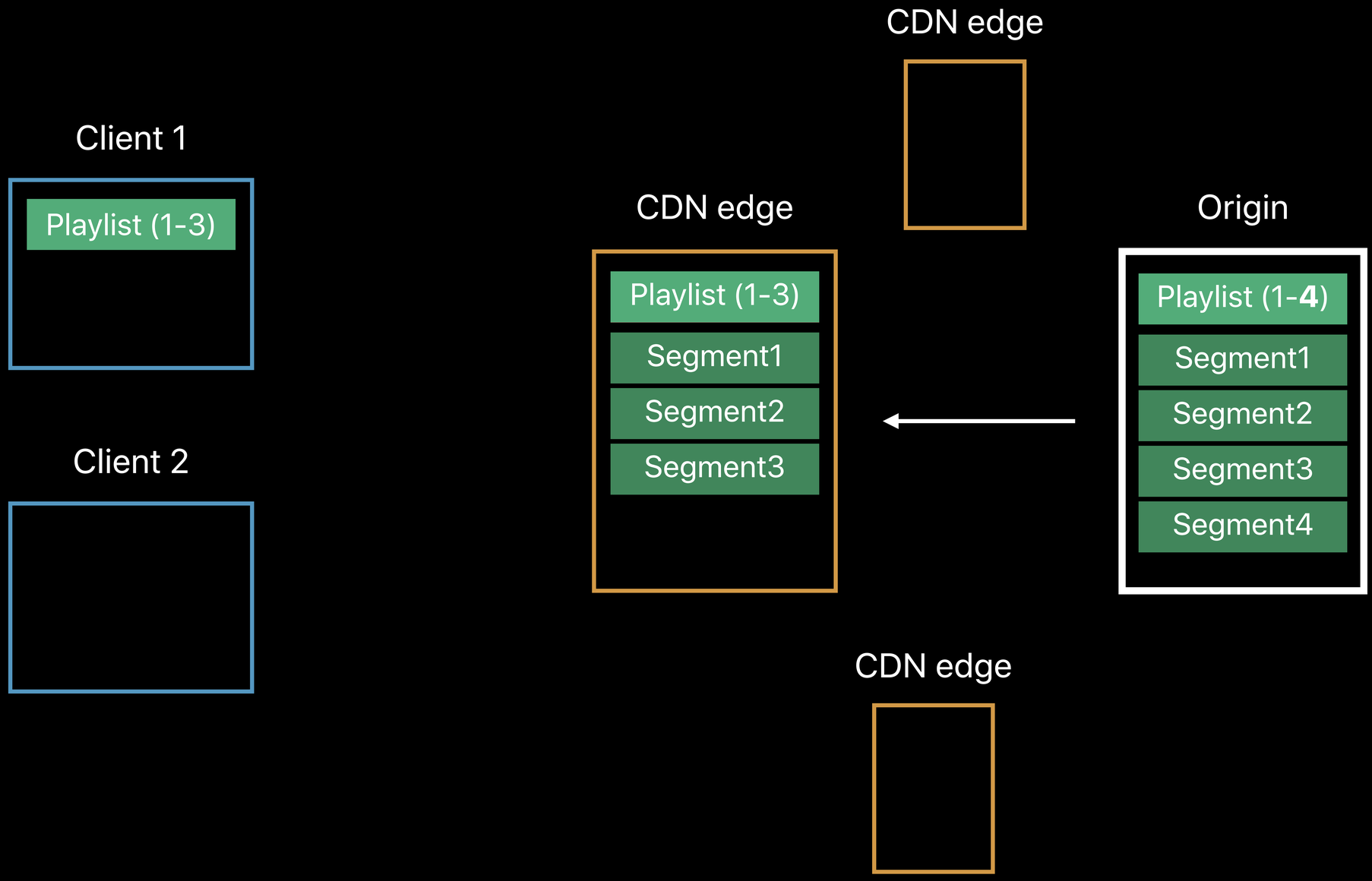

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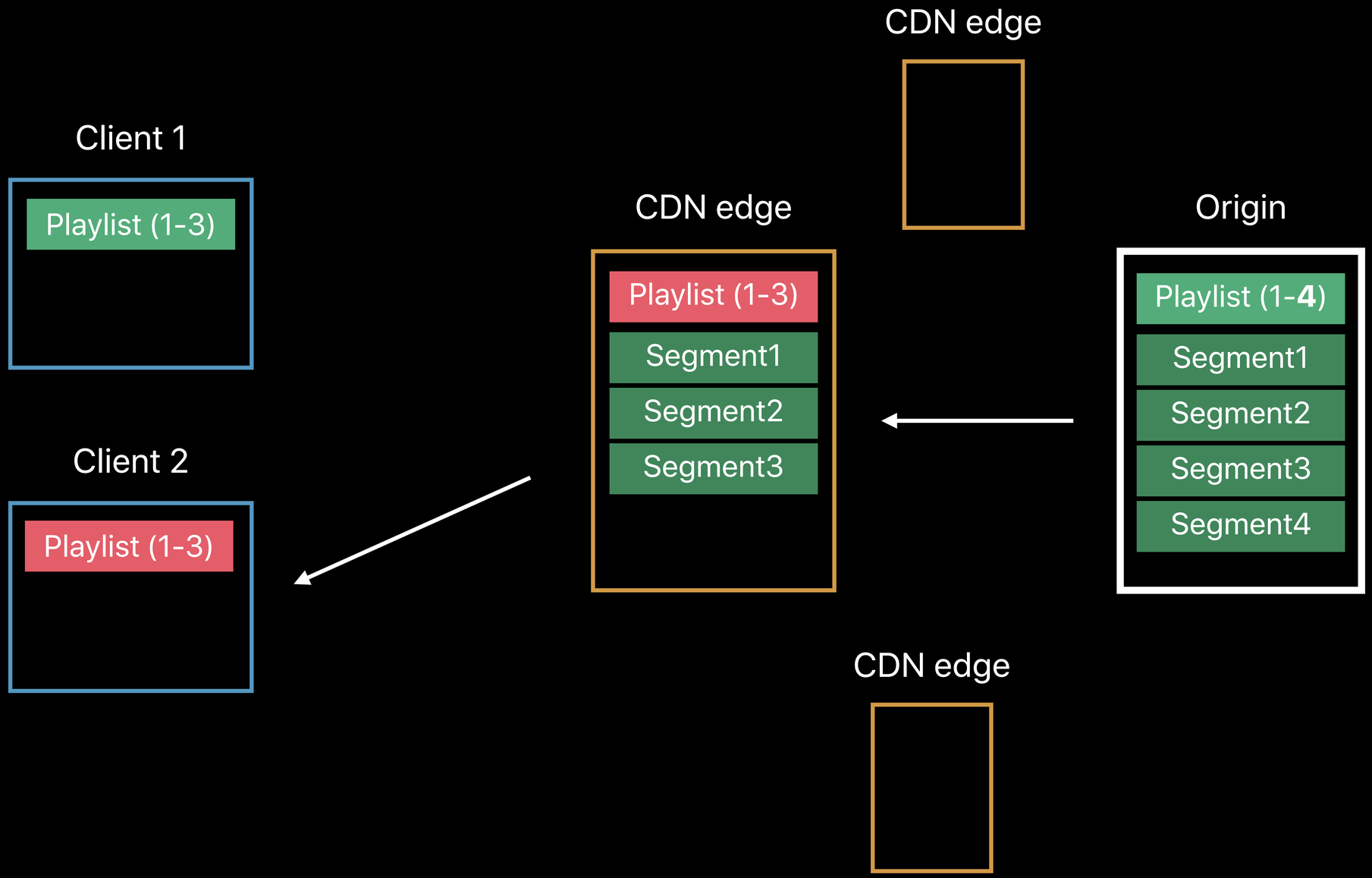

Considerations

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HTTP is still the king

Keeping HTTP means keeping segment encode delay

- Segments must become smaller: ~250 milliseconds

CDNs are essential to scale

- Caches are gonna cache

Runway to react is much shorter

- Must switch in ~600 milliseconds instead of 10 seconds

5 Changes

Reduce Publishing Latency

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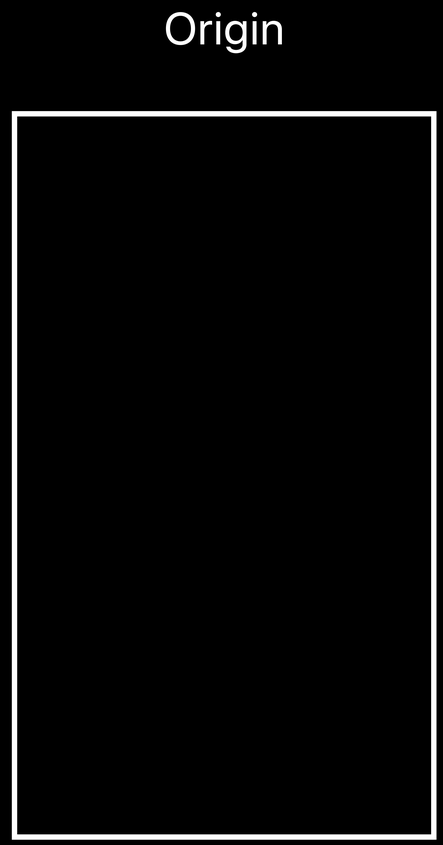

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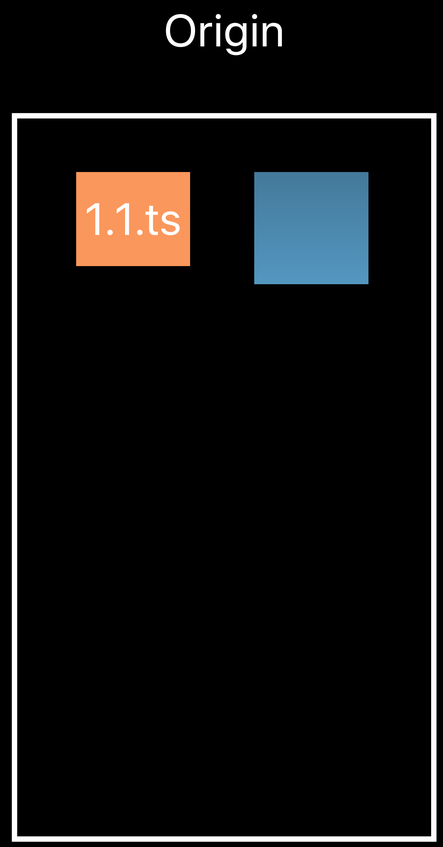

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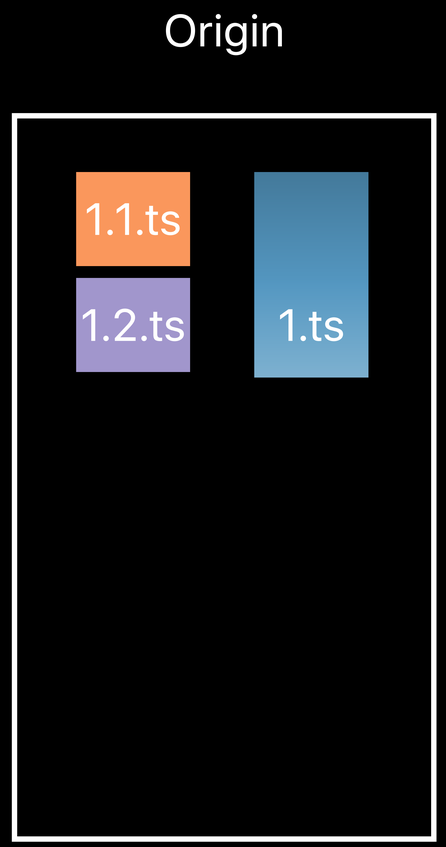

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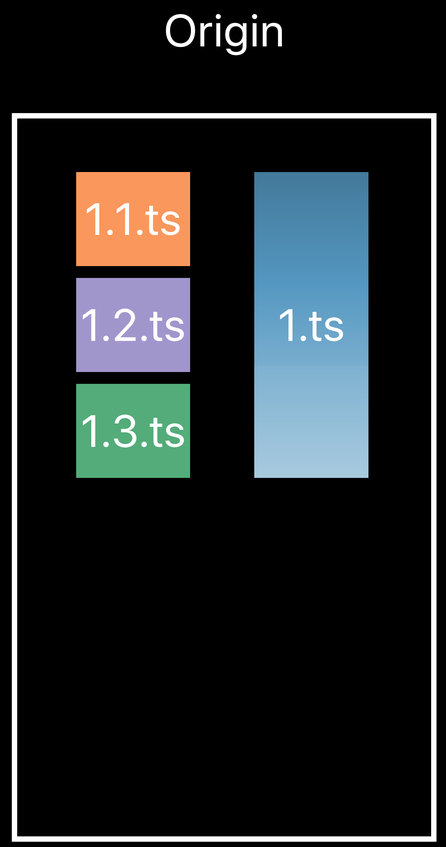
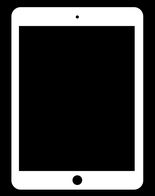


Optimize Segment Discovery

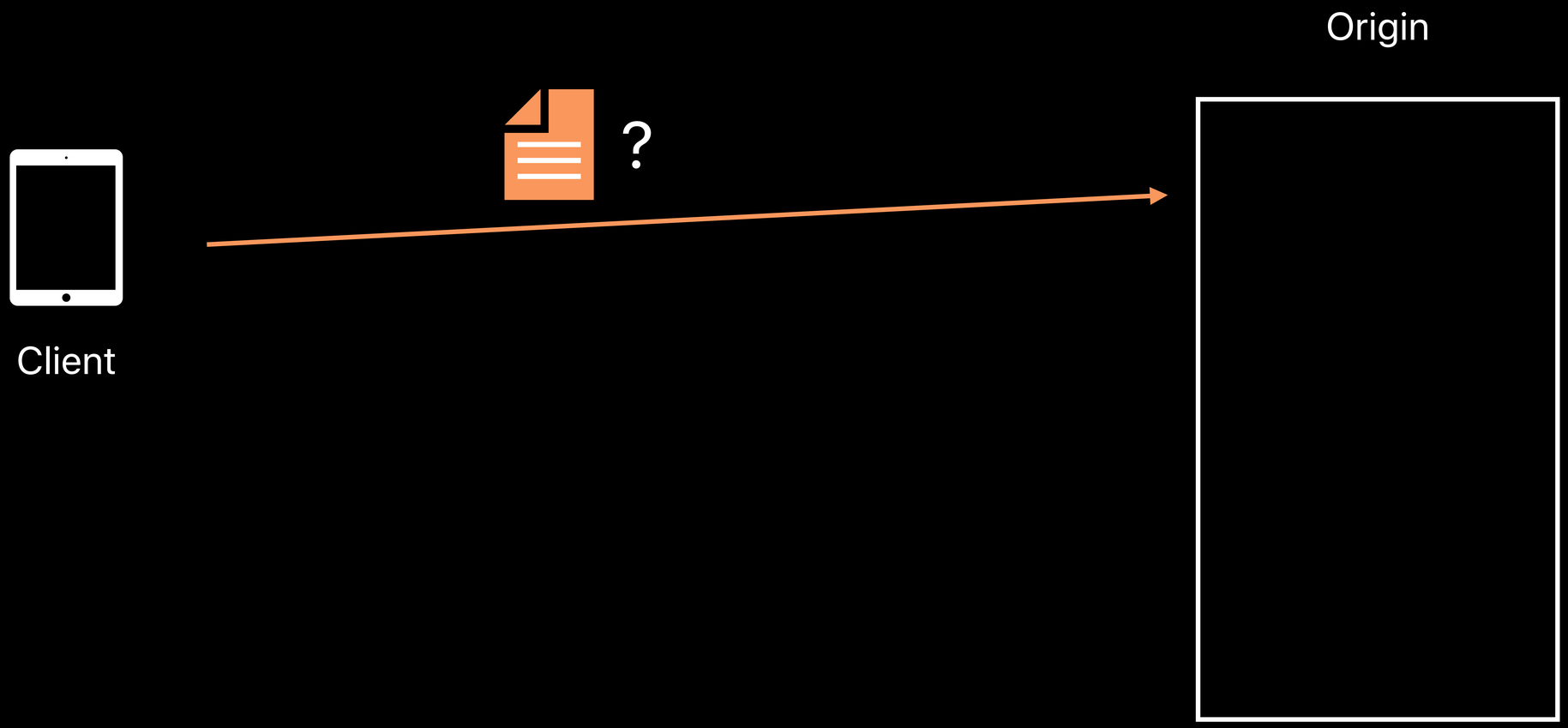
Optimize Discovery

Origin



Client

Optimize Segment Discovery



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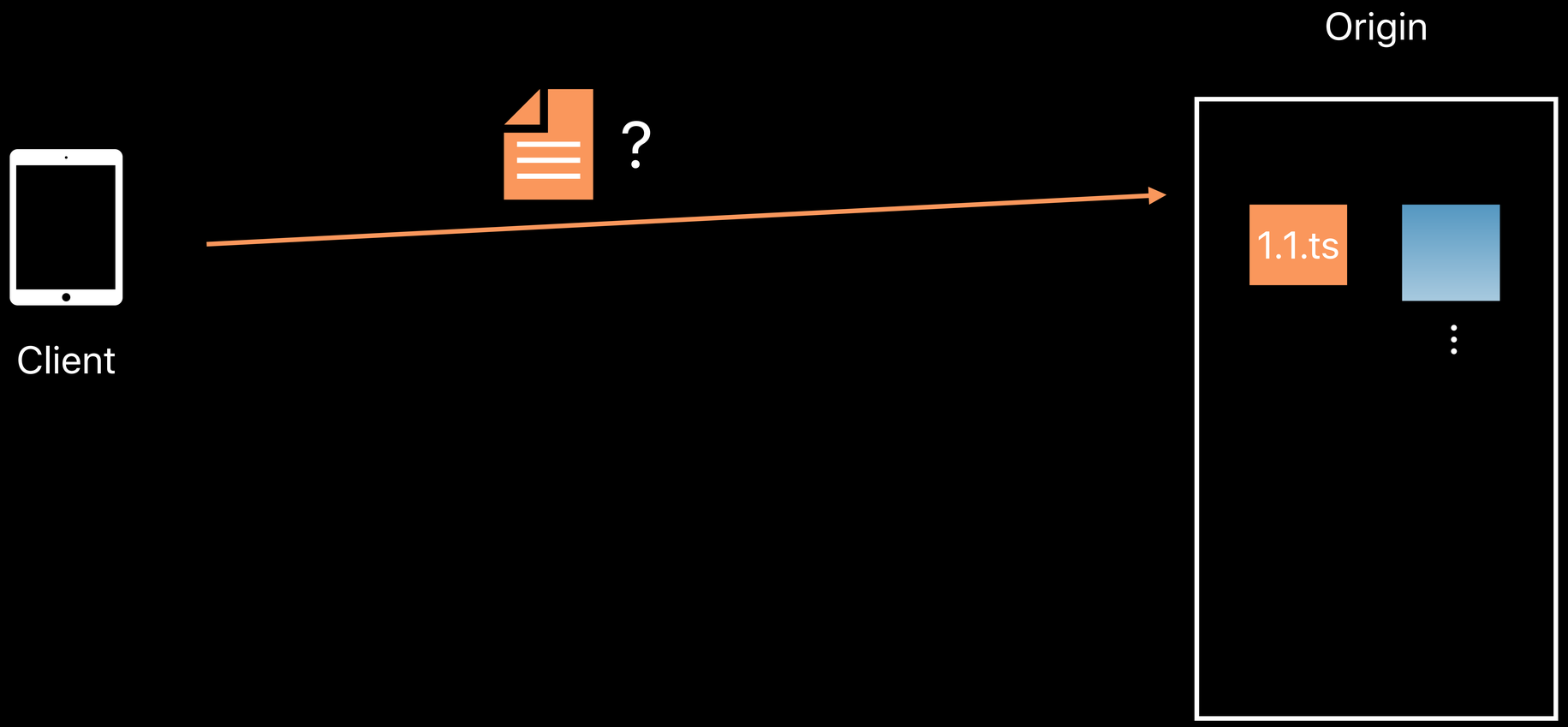

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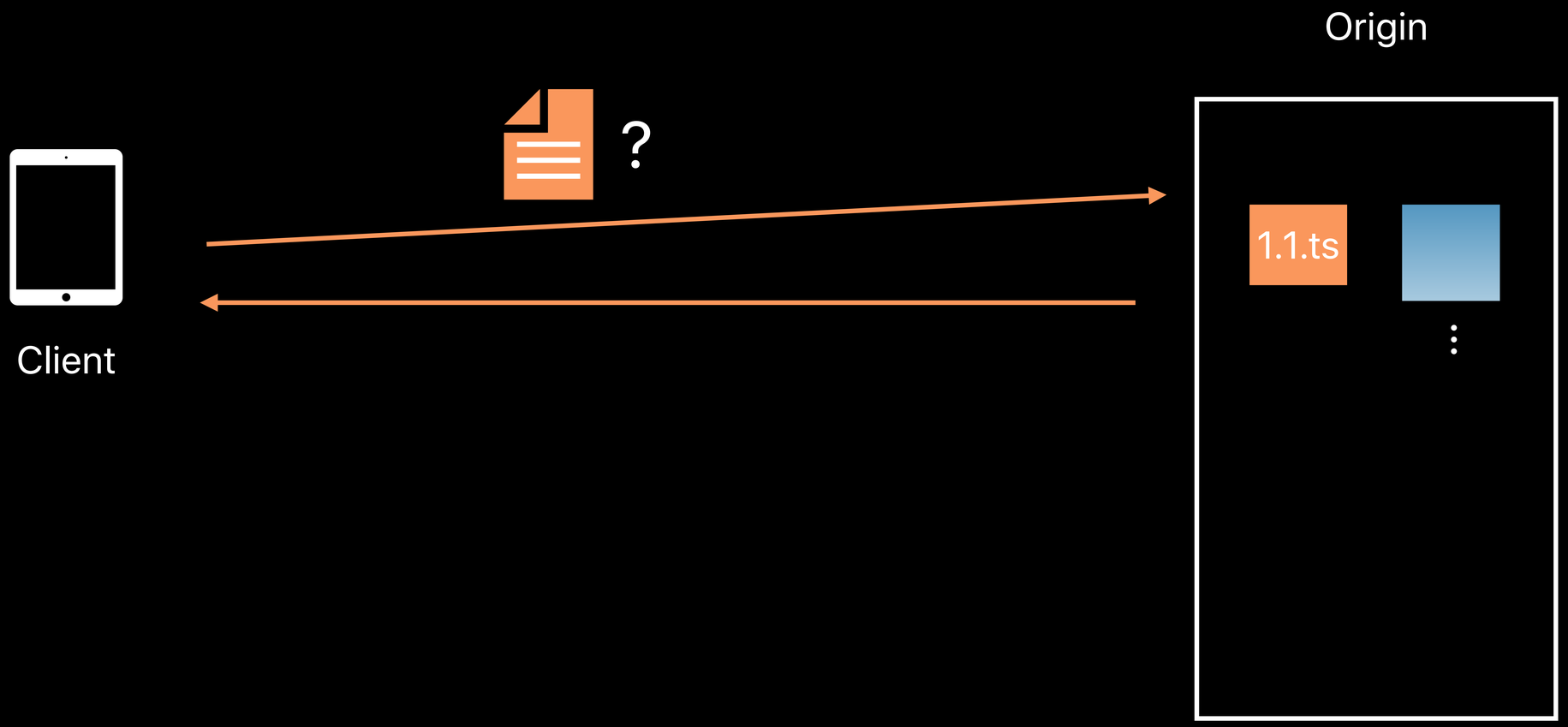

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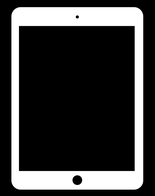
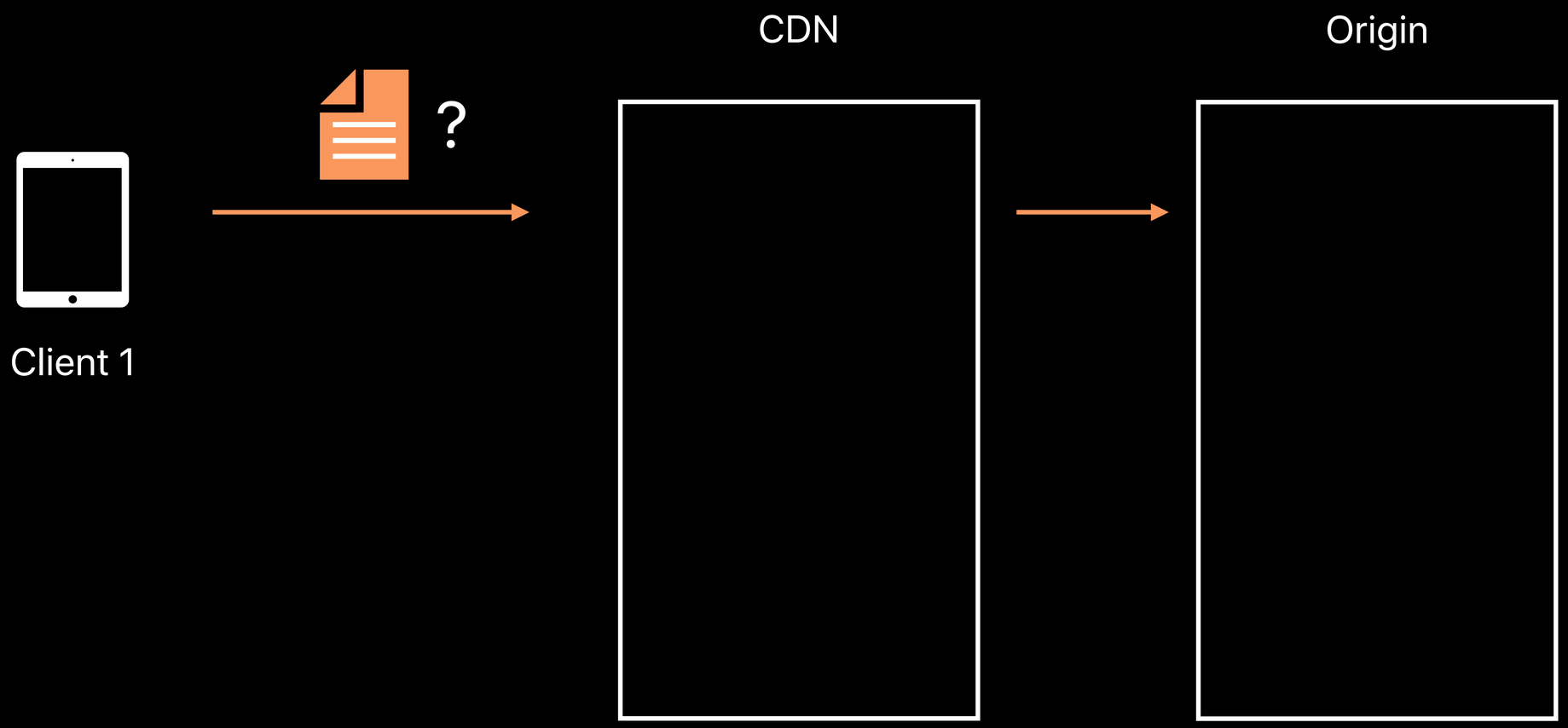


Client 1

CDN

Origin

Improve Caching Behavior



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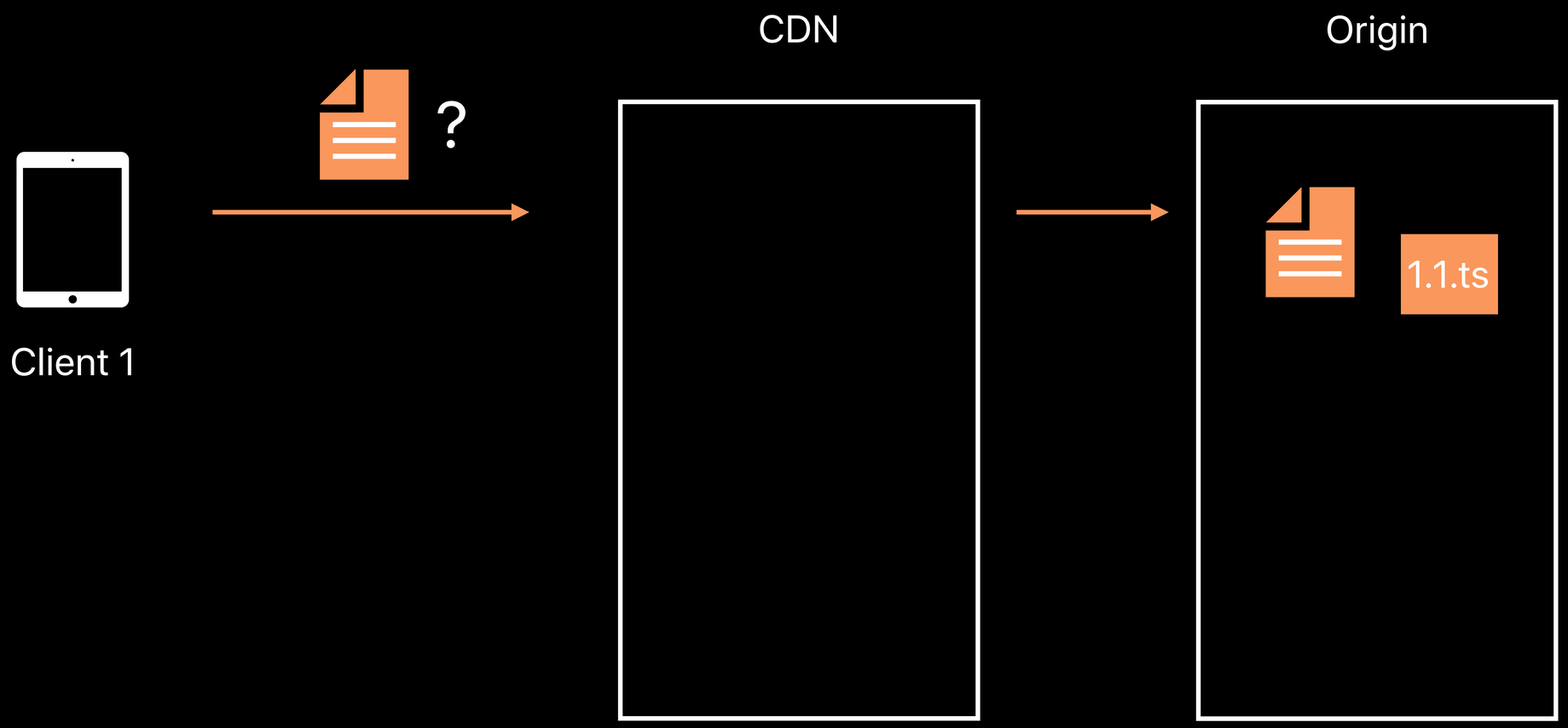

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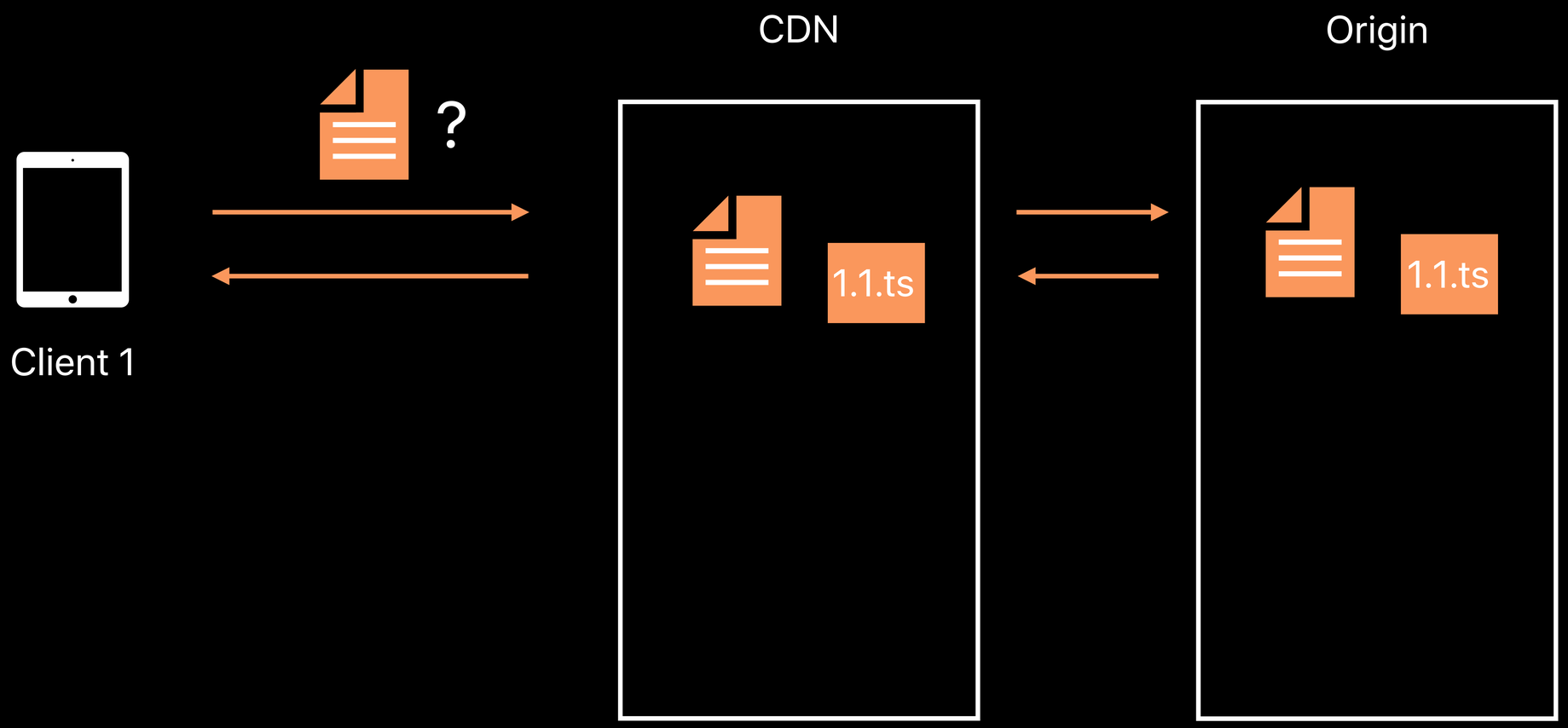

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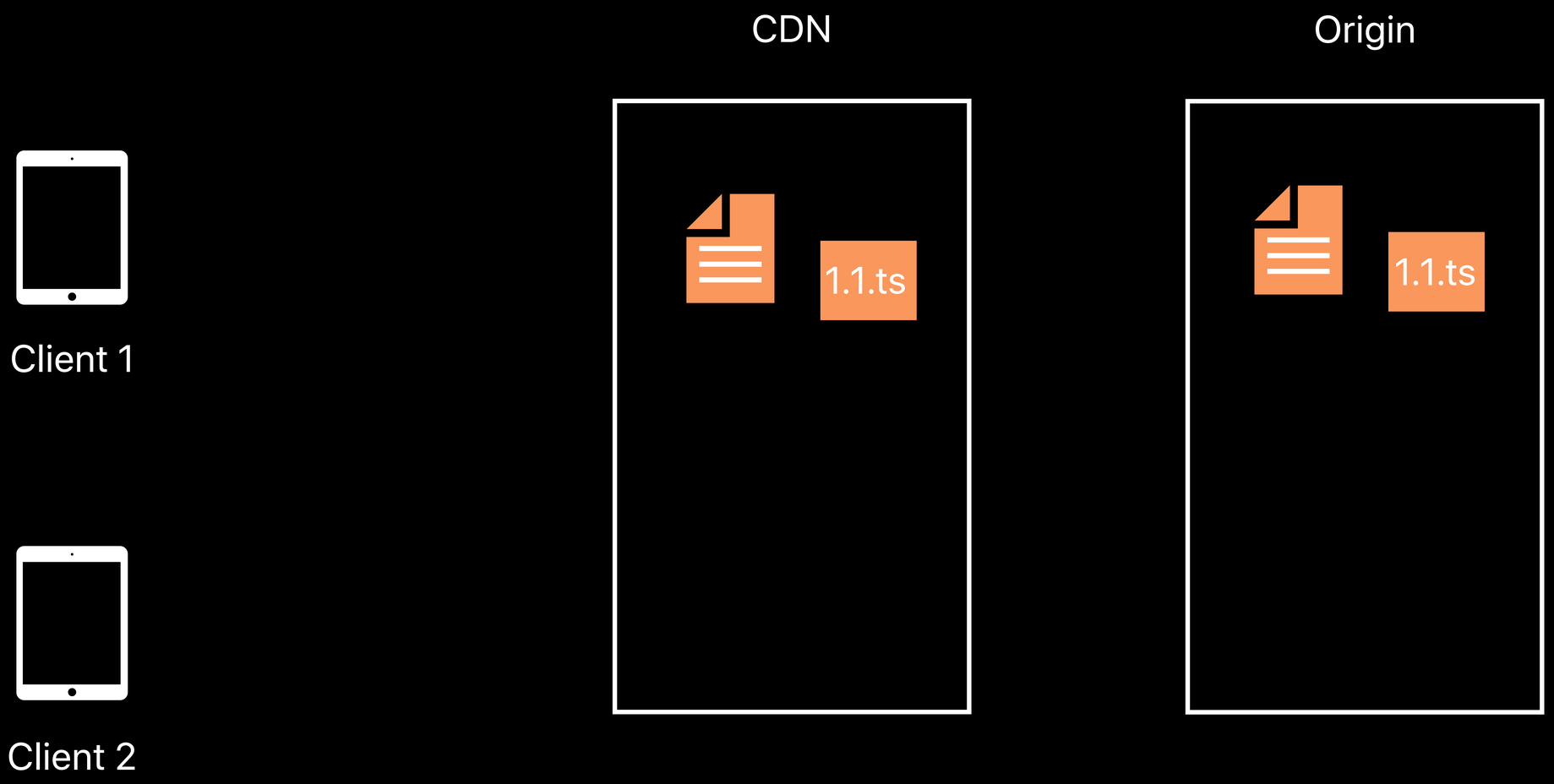

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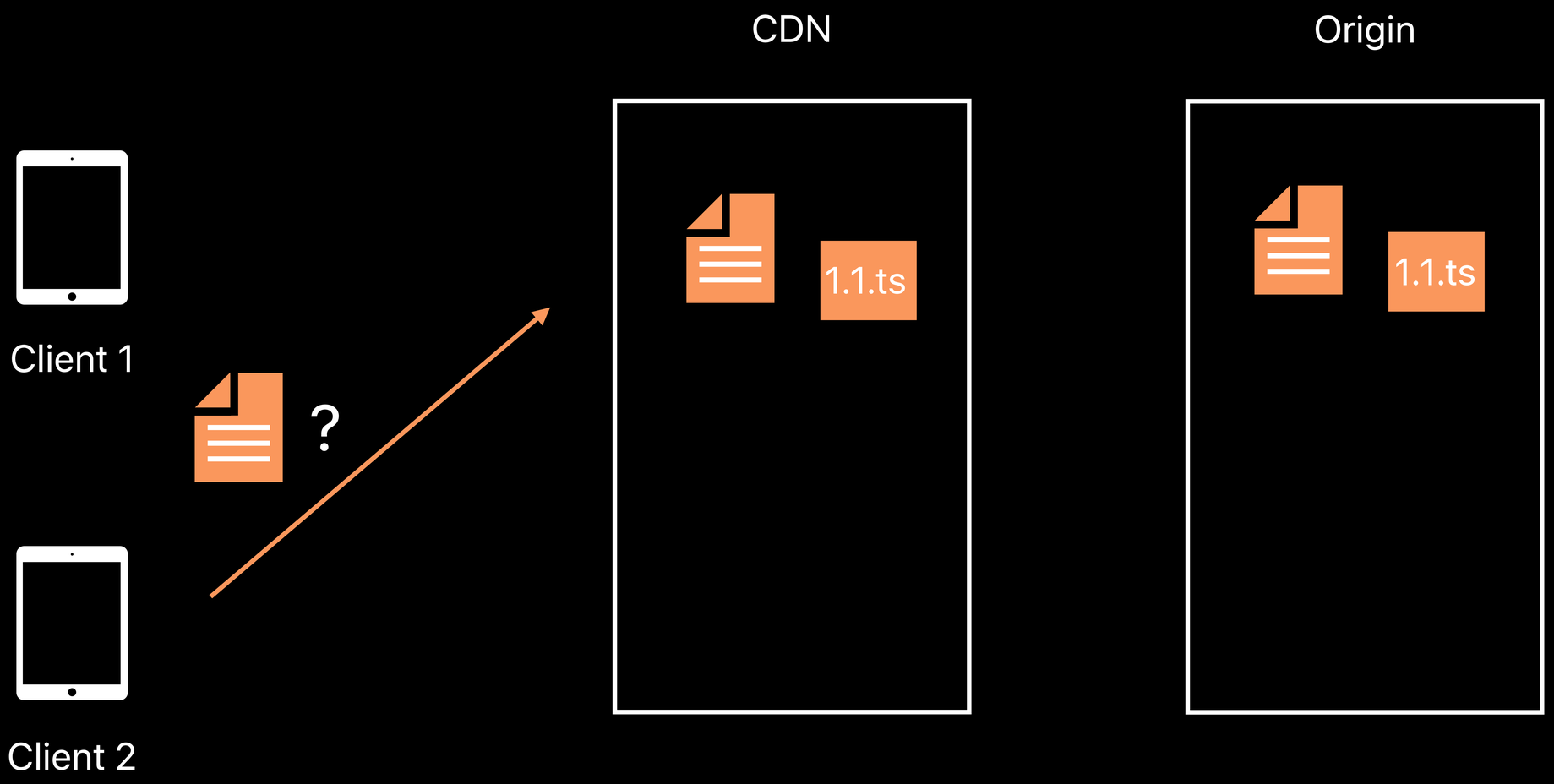

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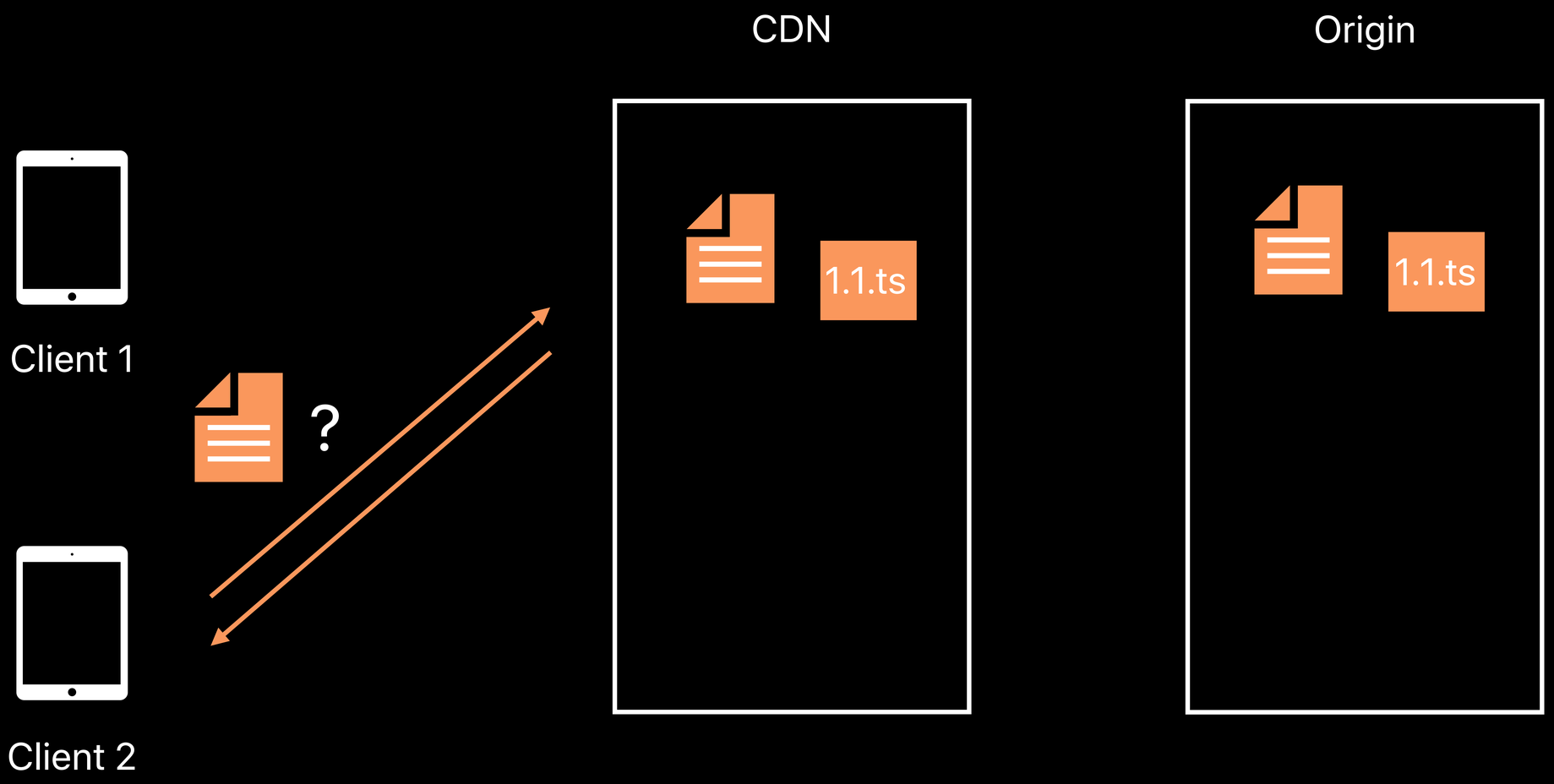

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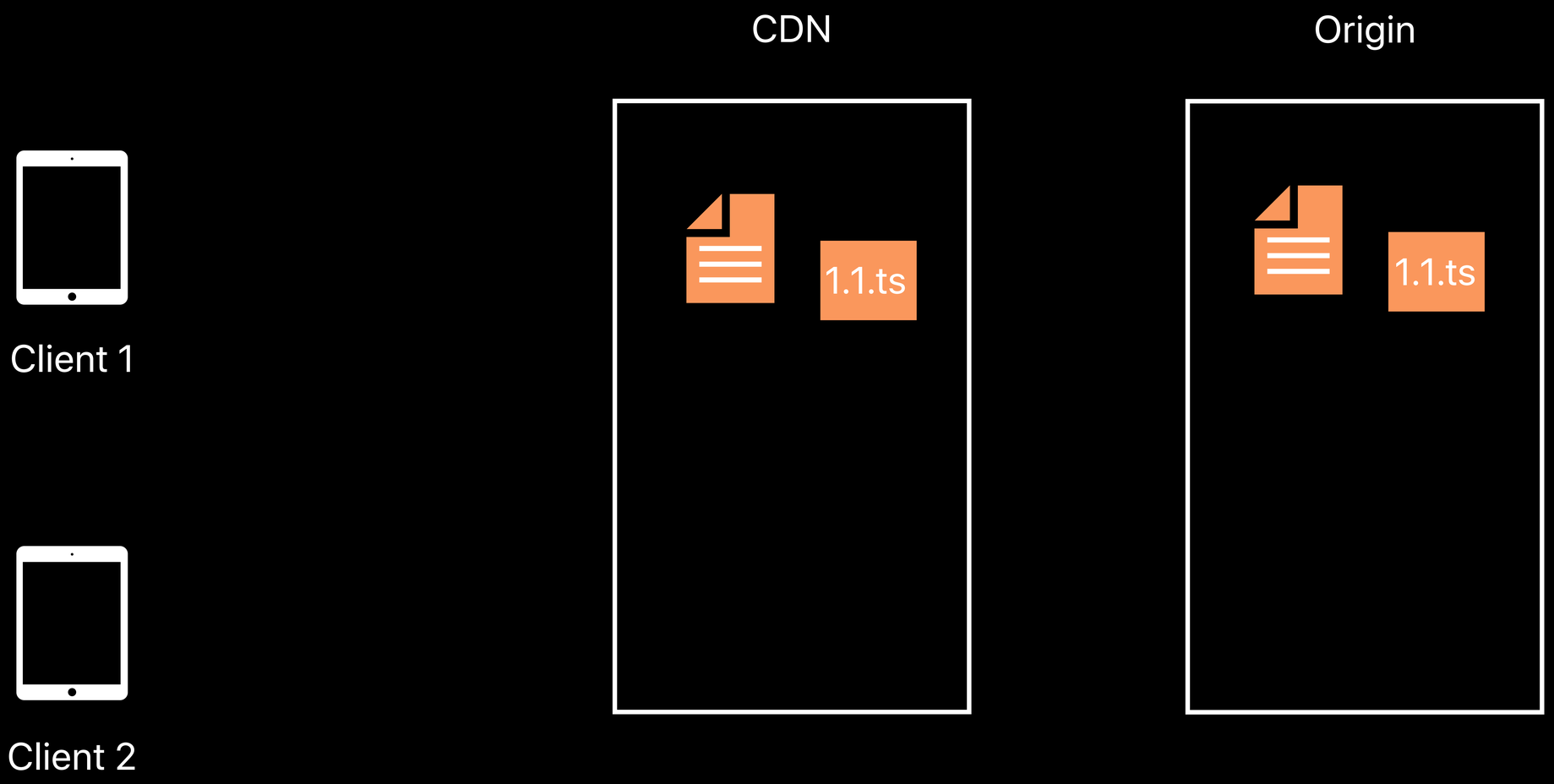

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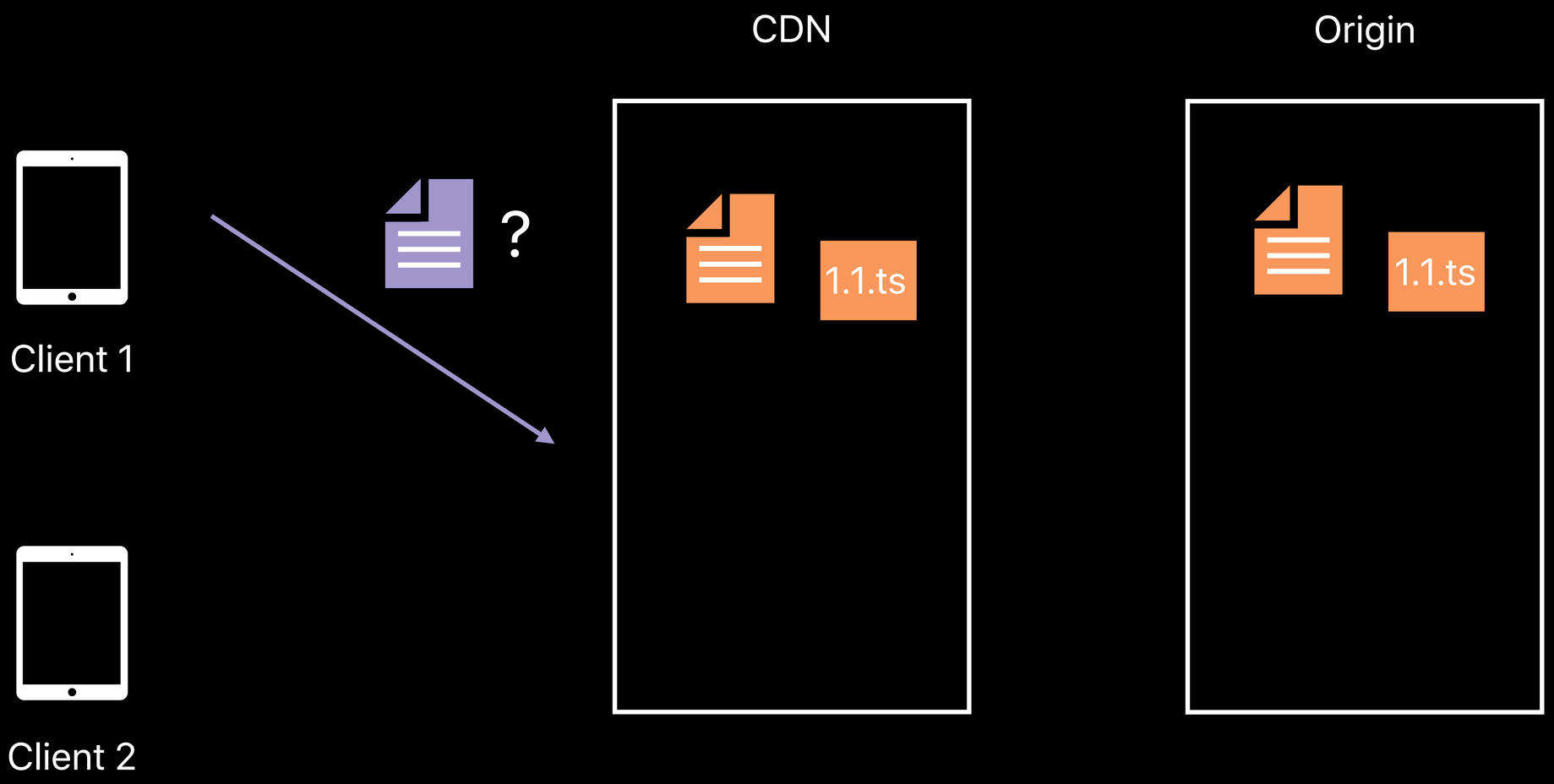

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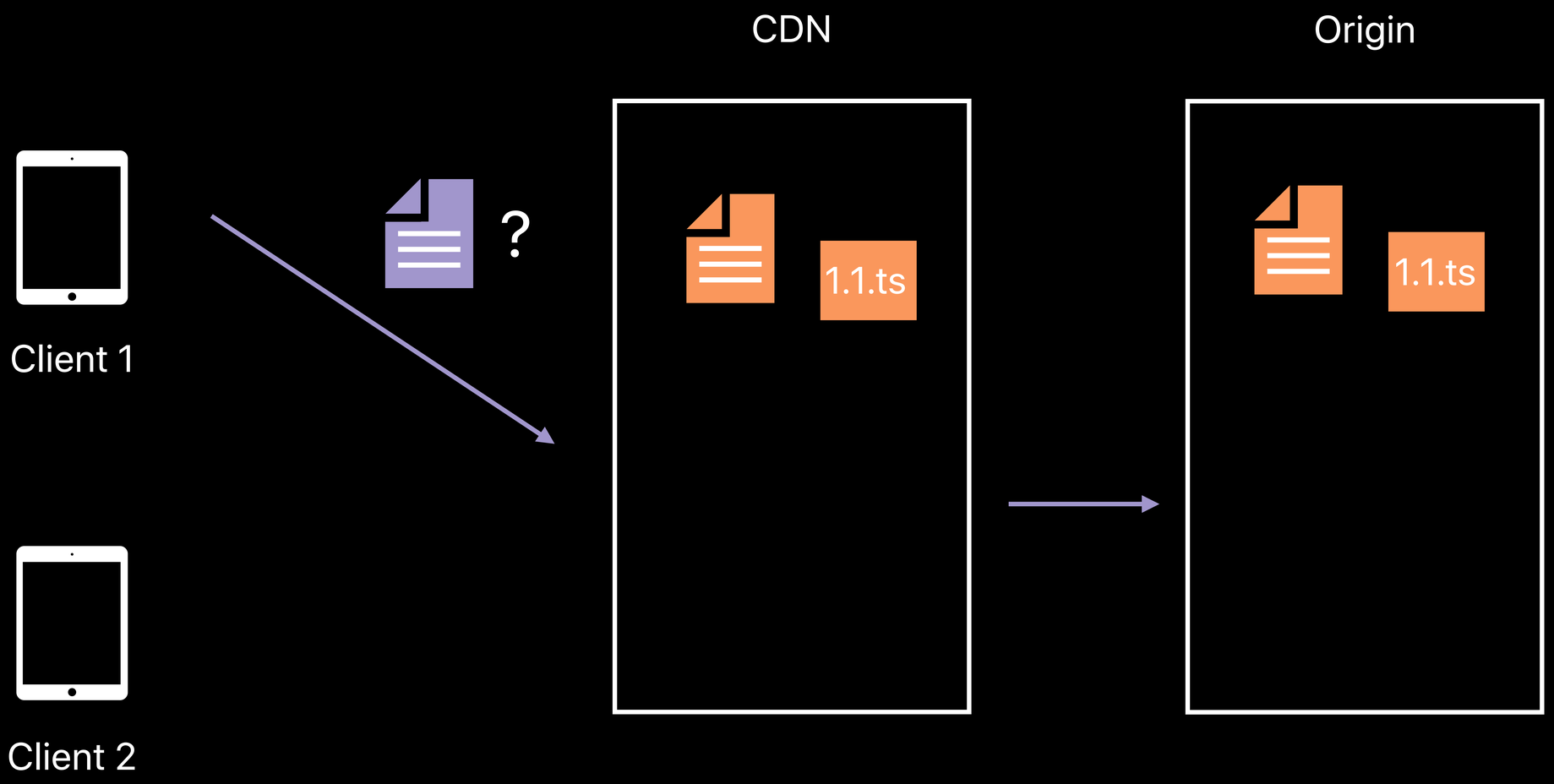

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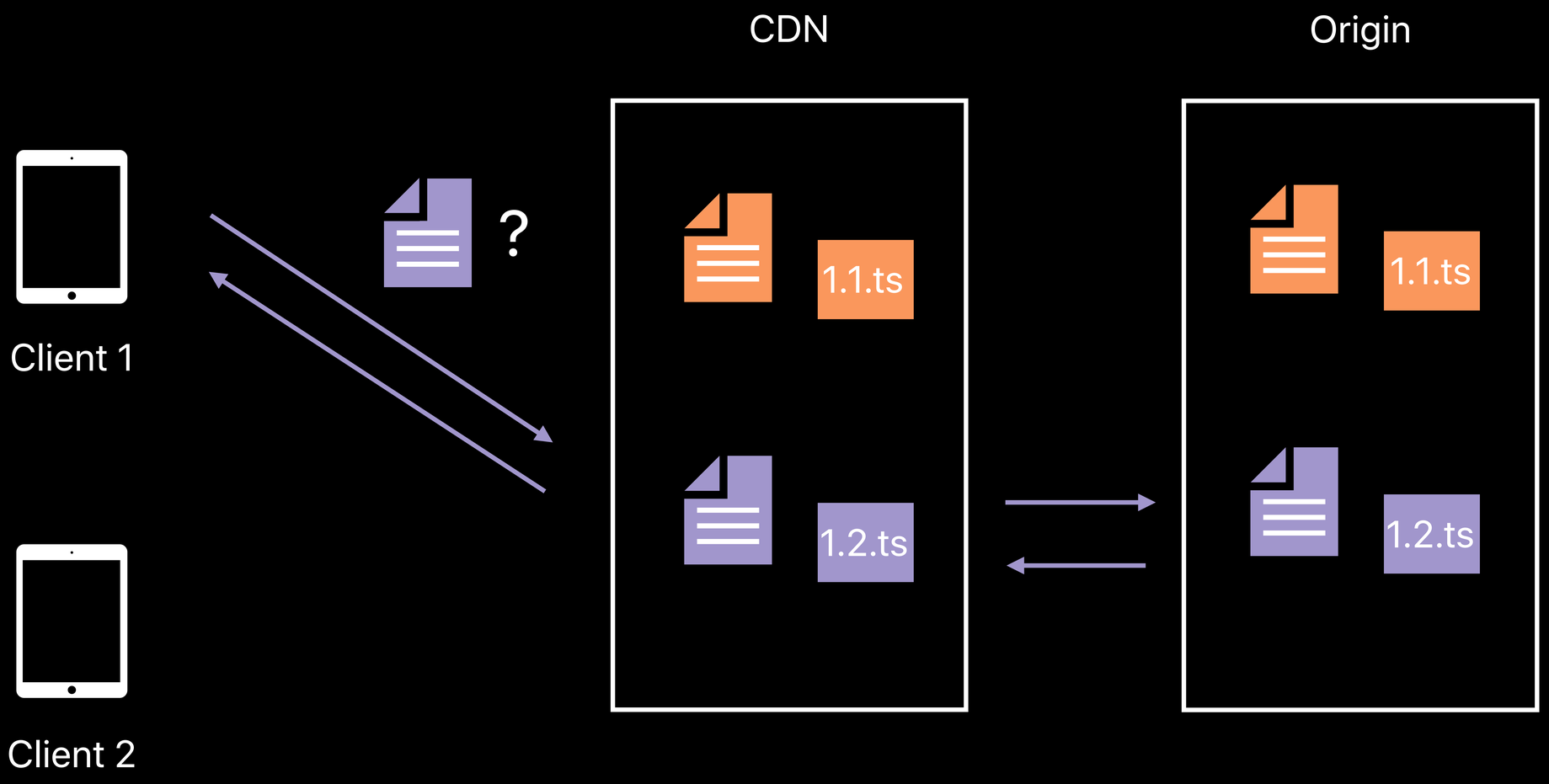
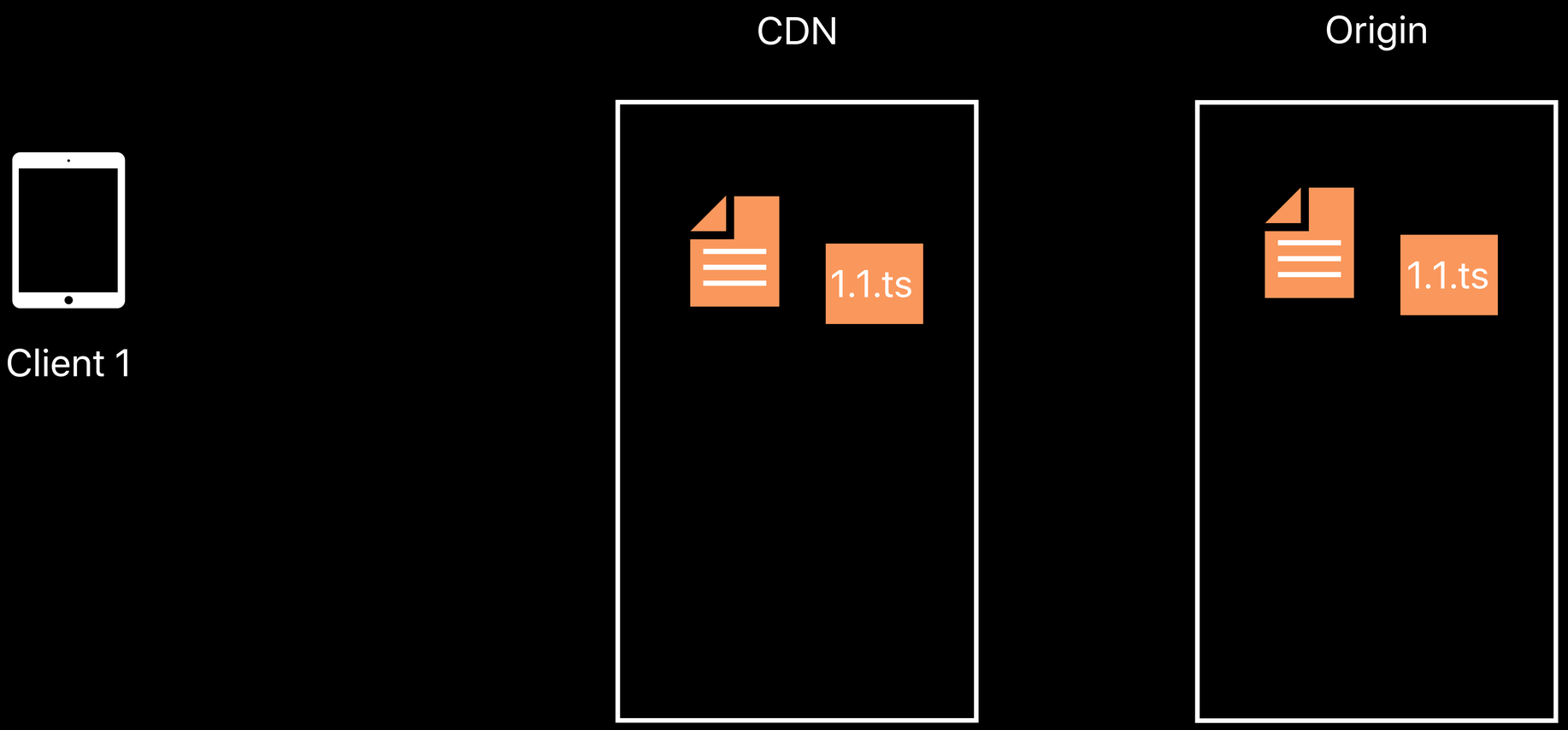


Eliminate Segment Round Trip

Eliminate Round Trips



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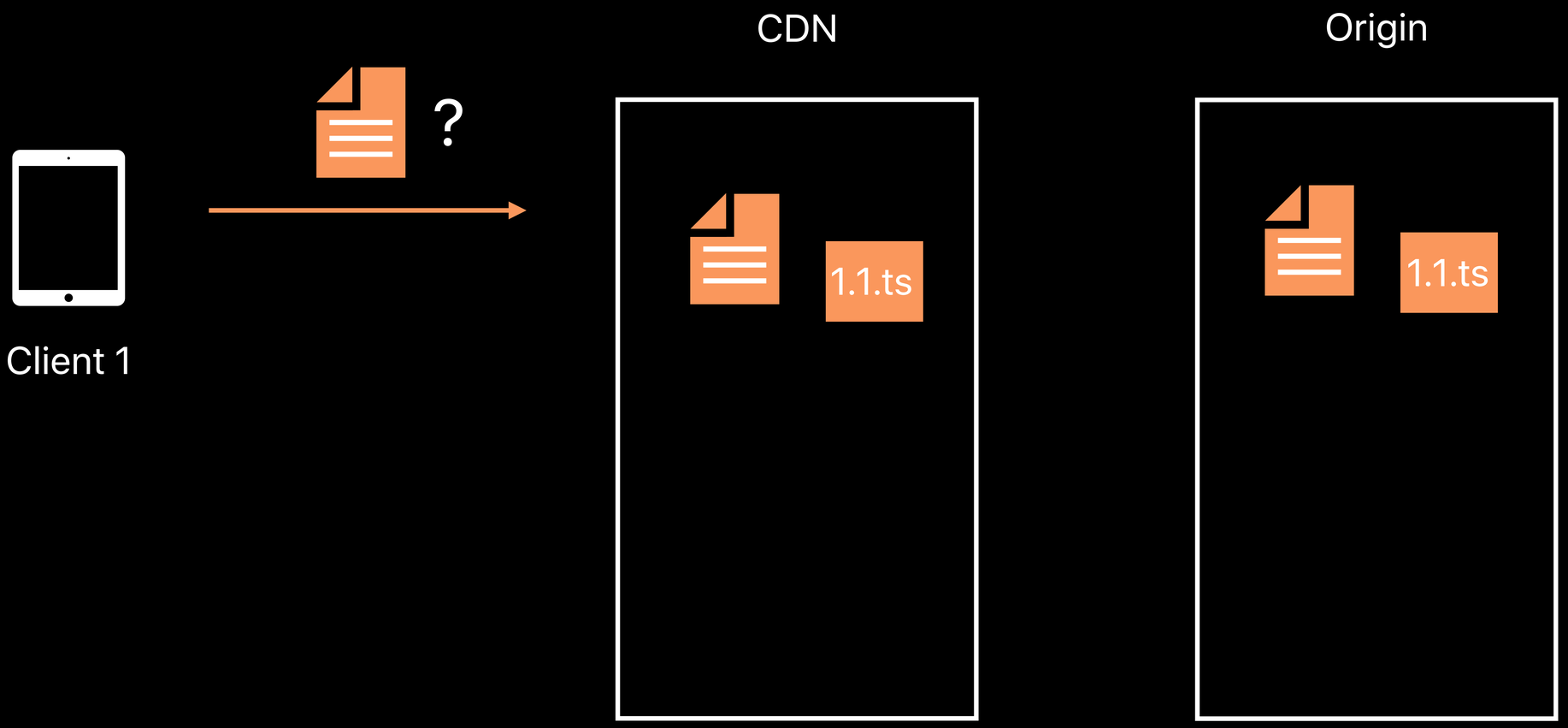

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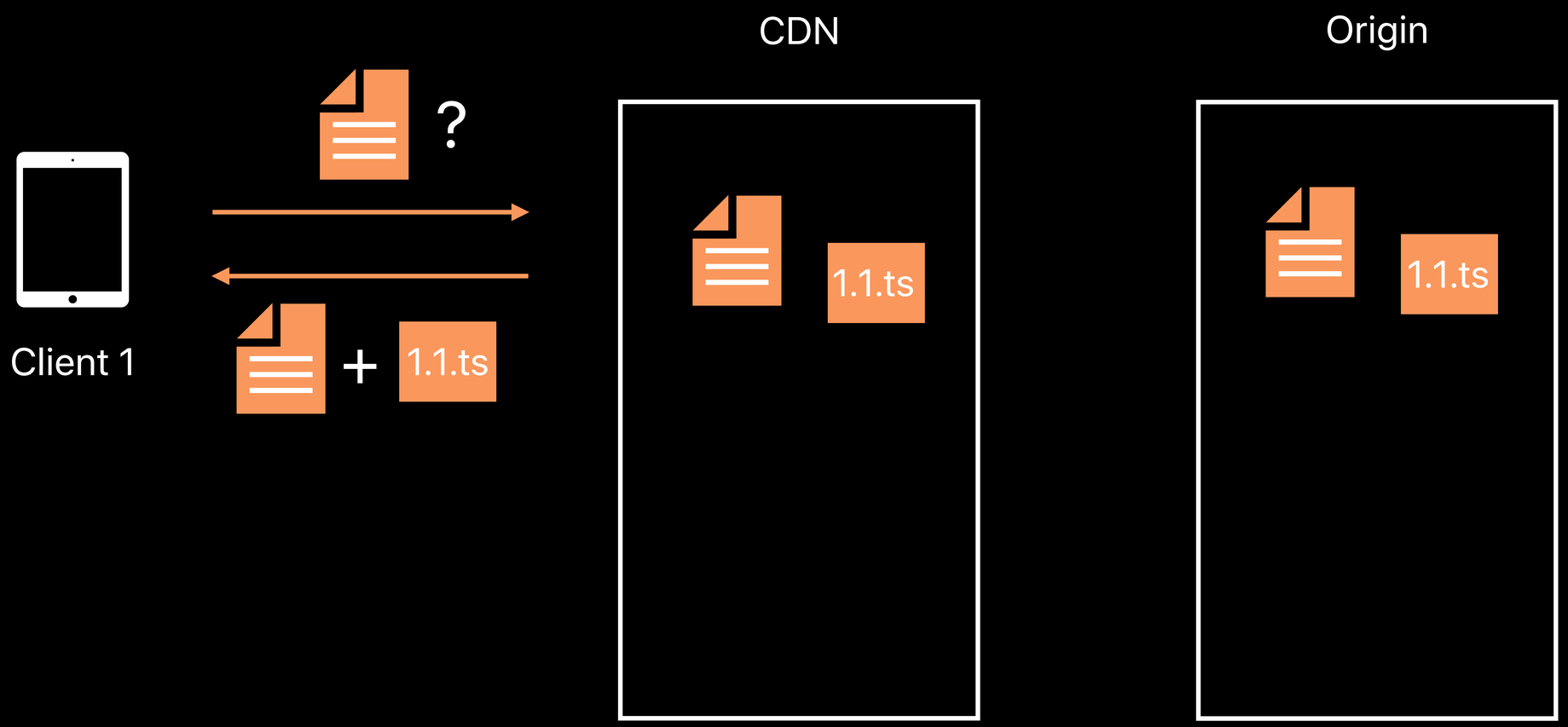
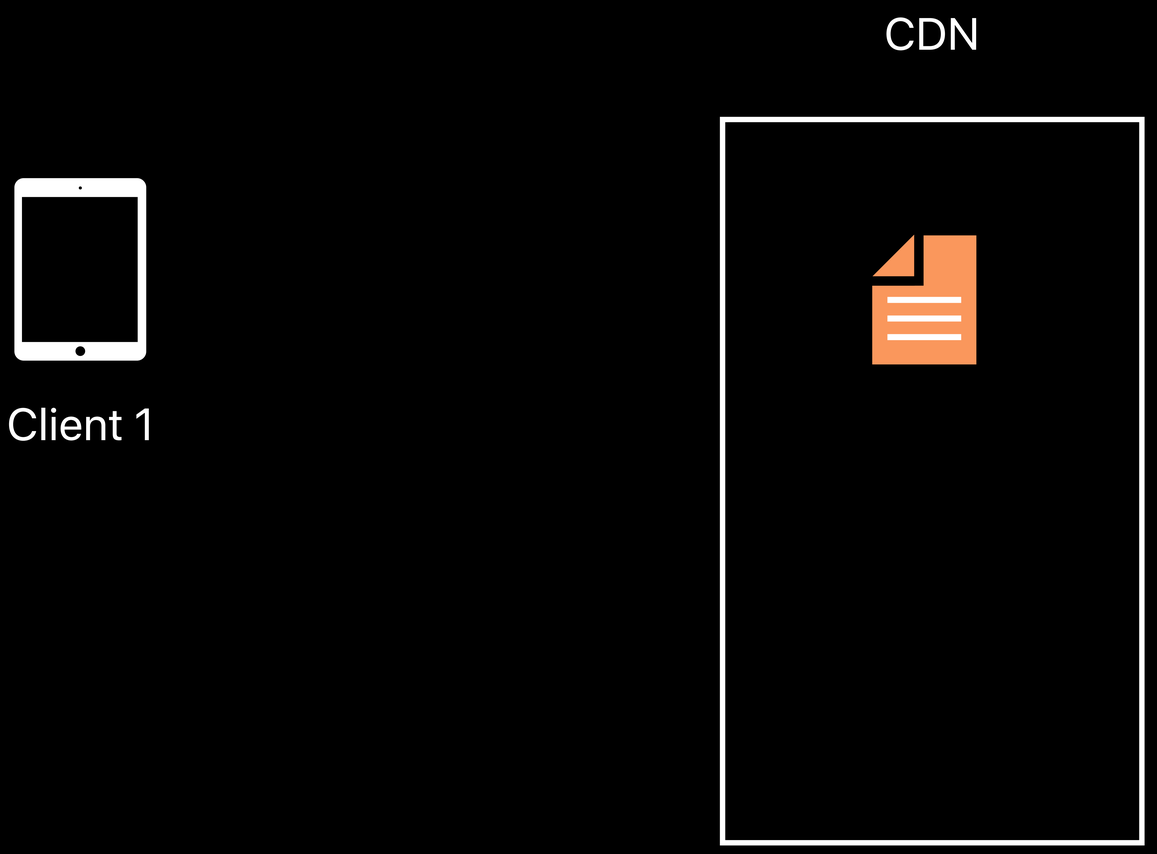


Reduce Playlist Transfer Overhead



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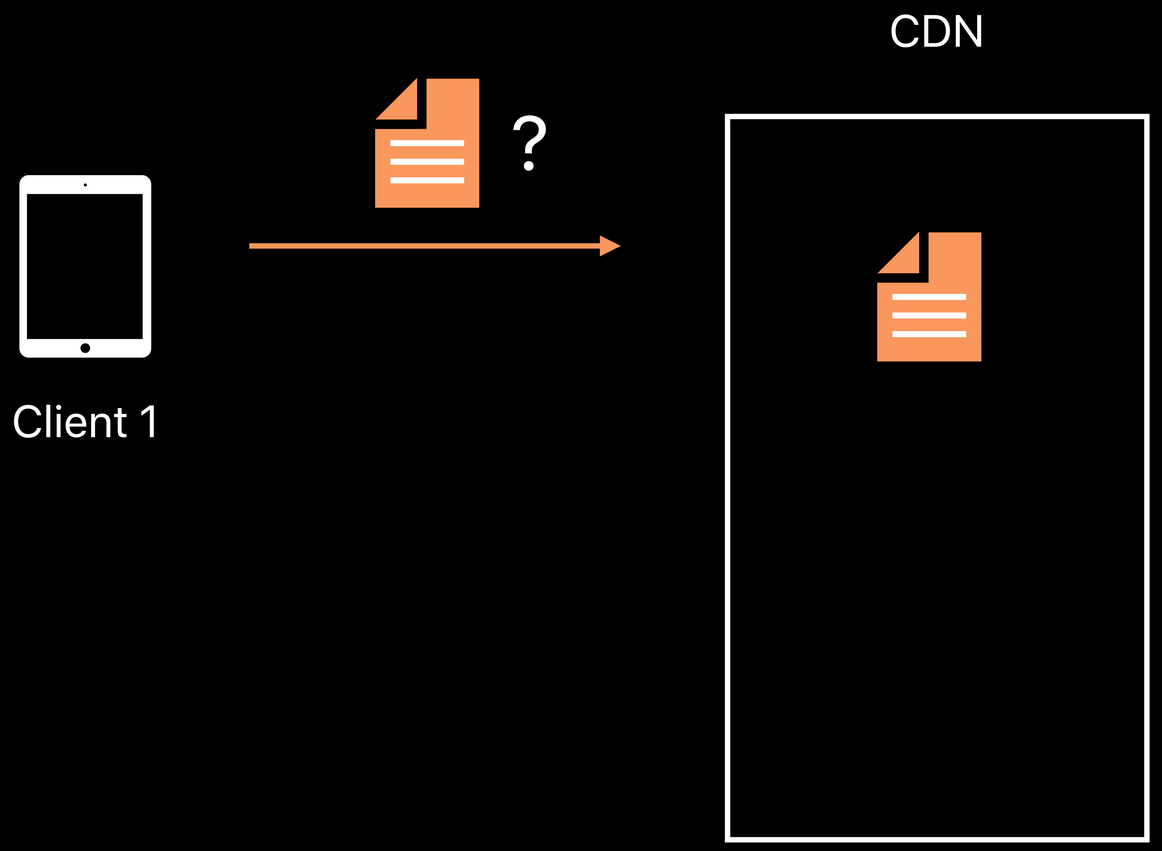

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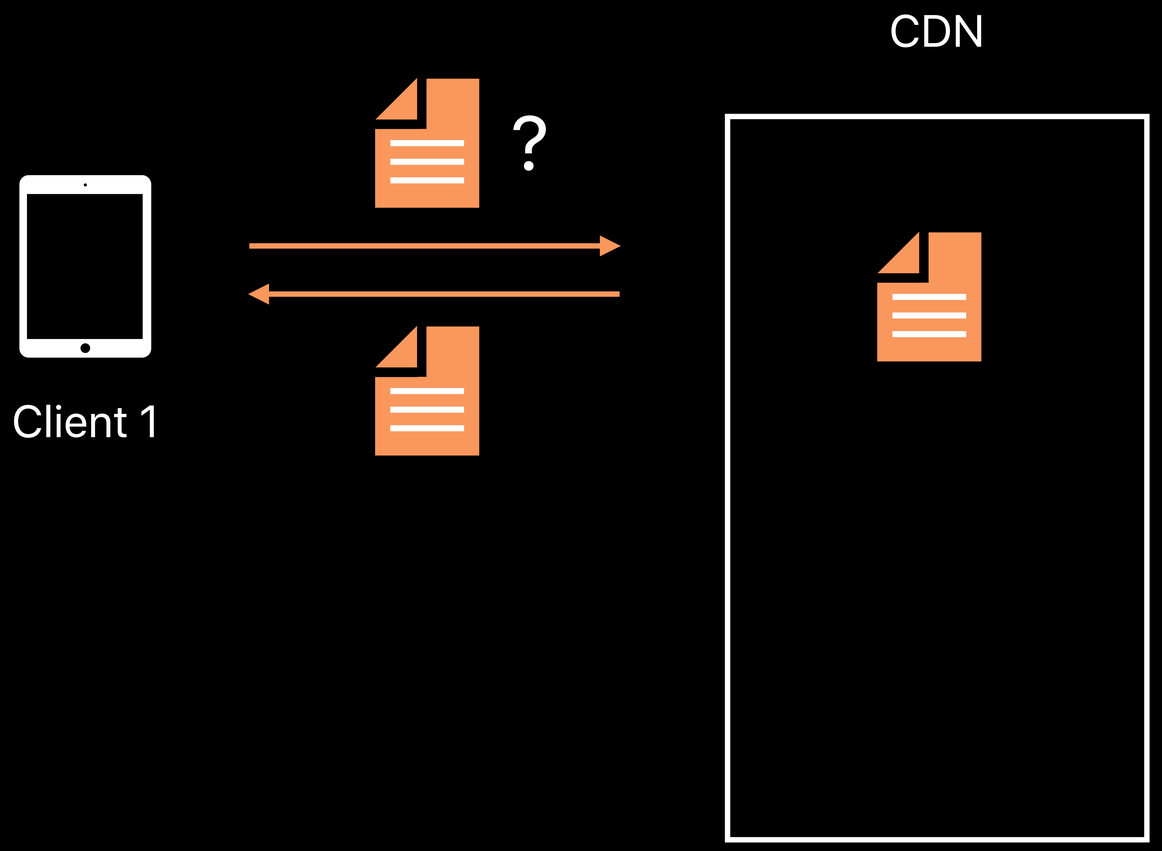

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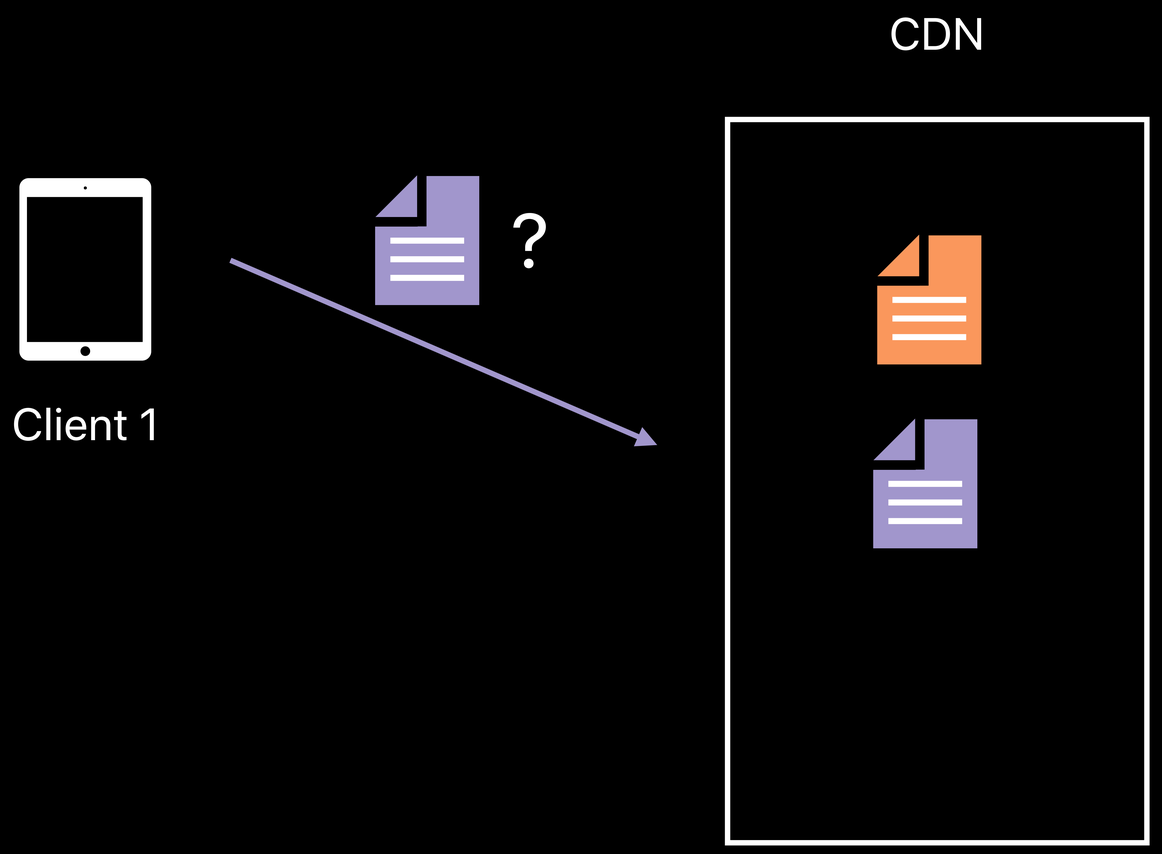

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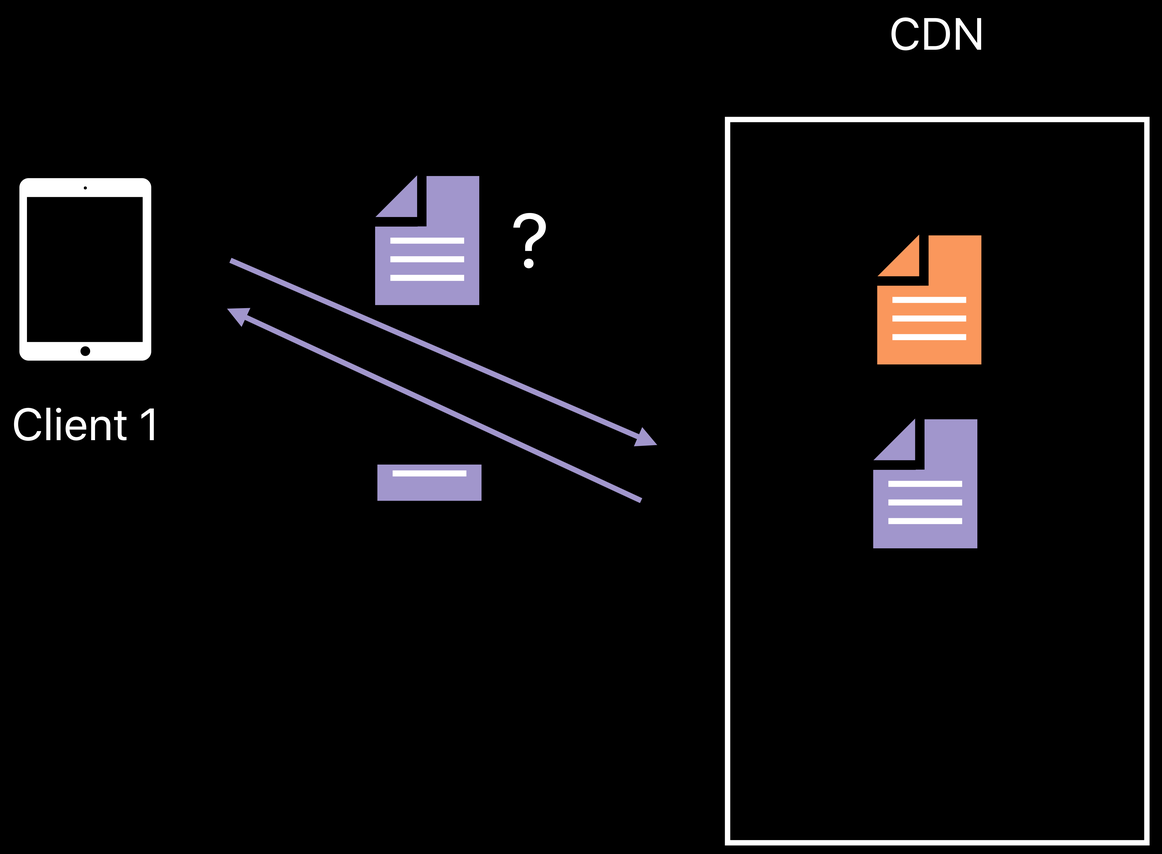

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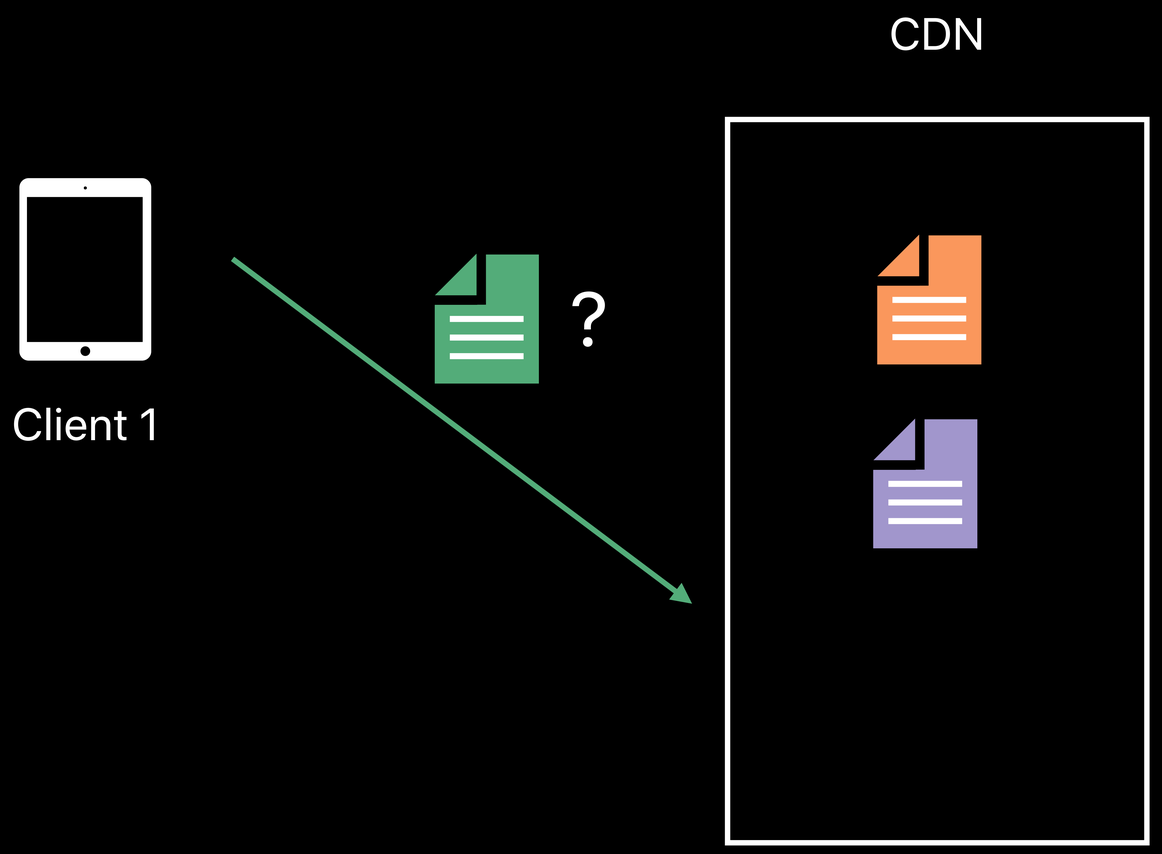

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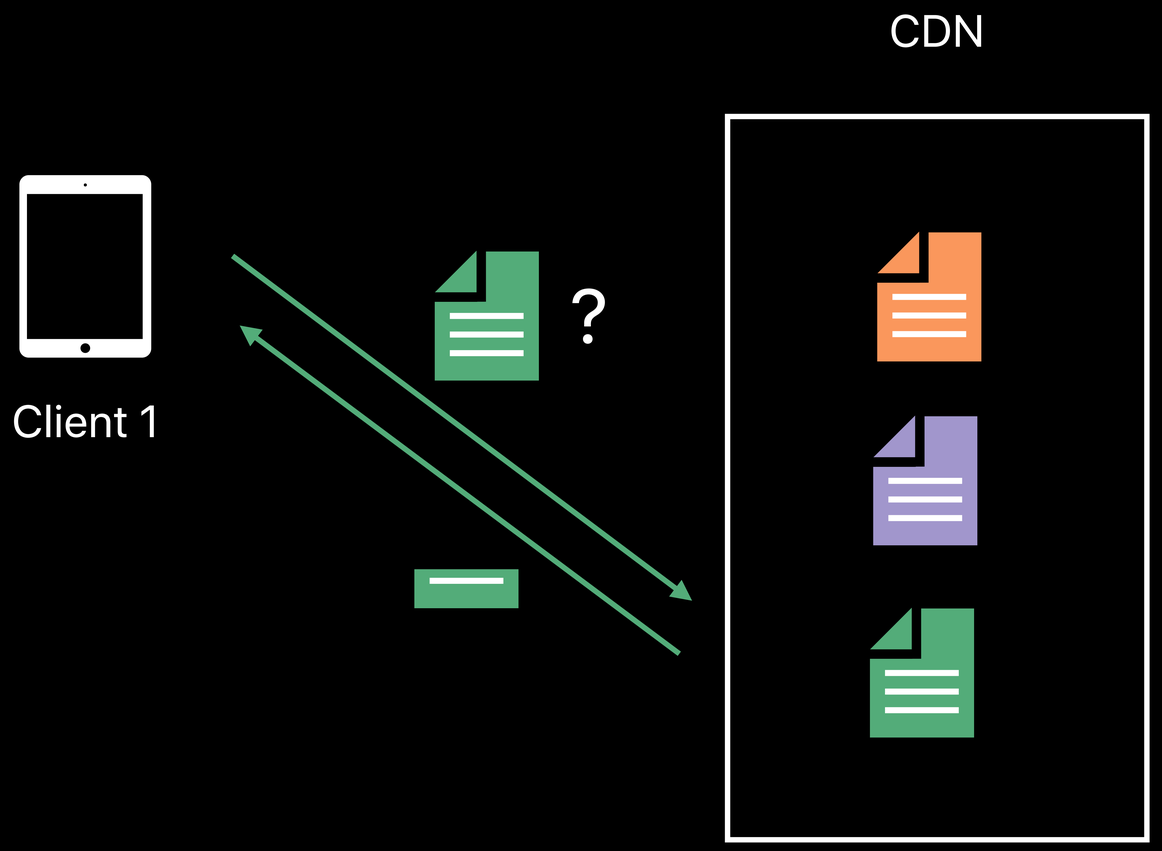
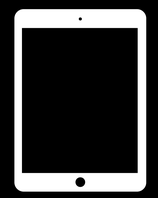
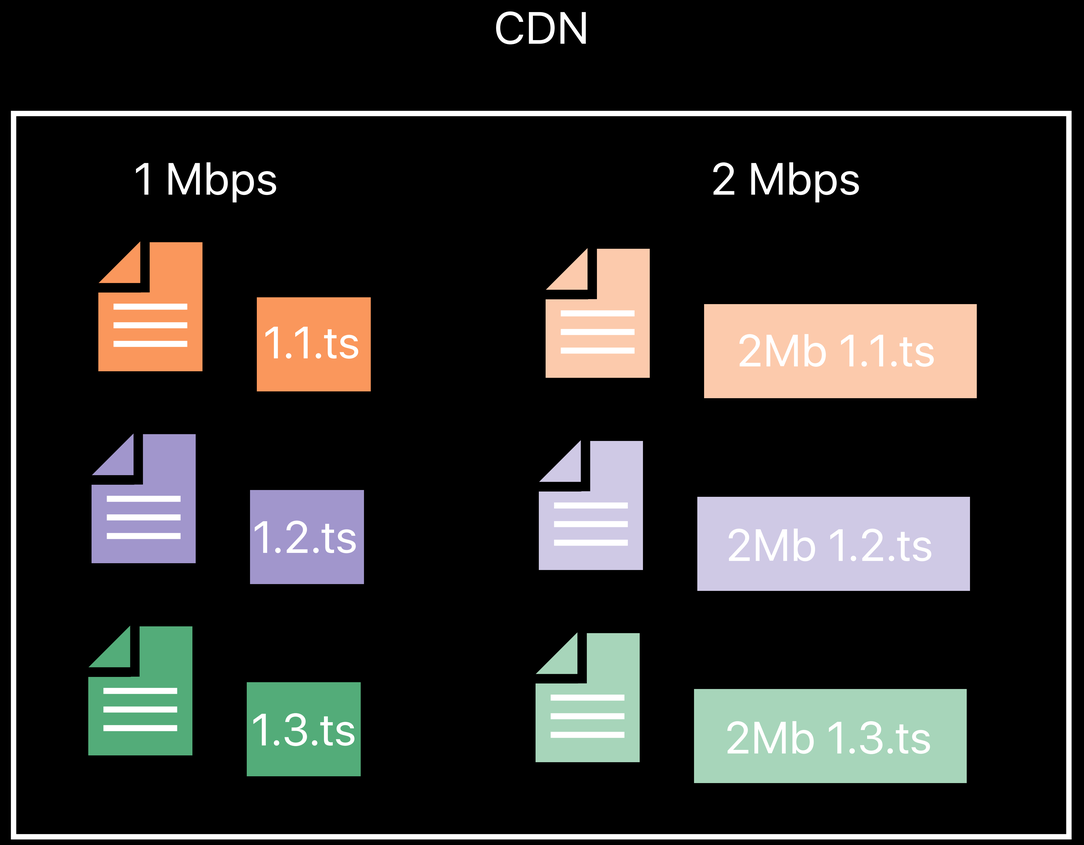


Switch Tiers Quickly



Client 1



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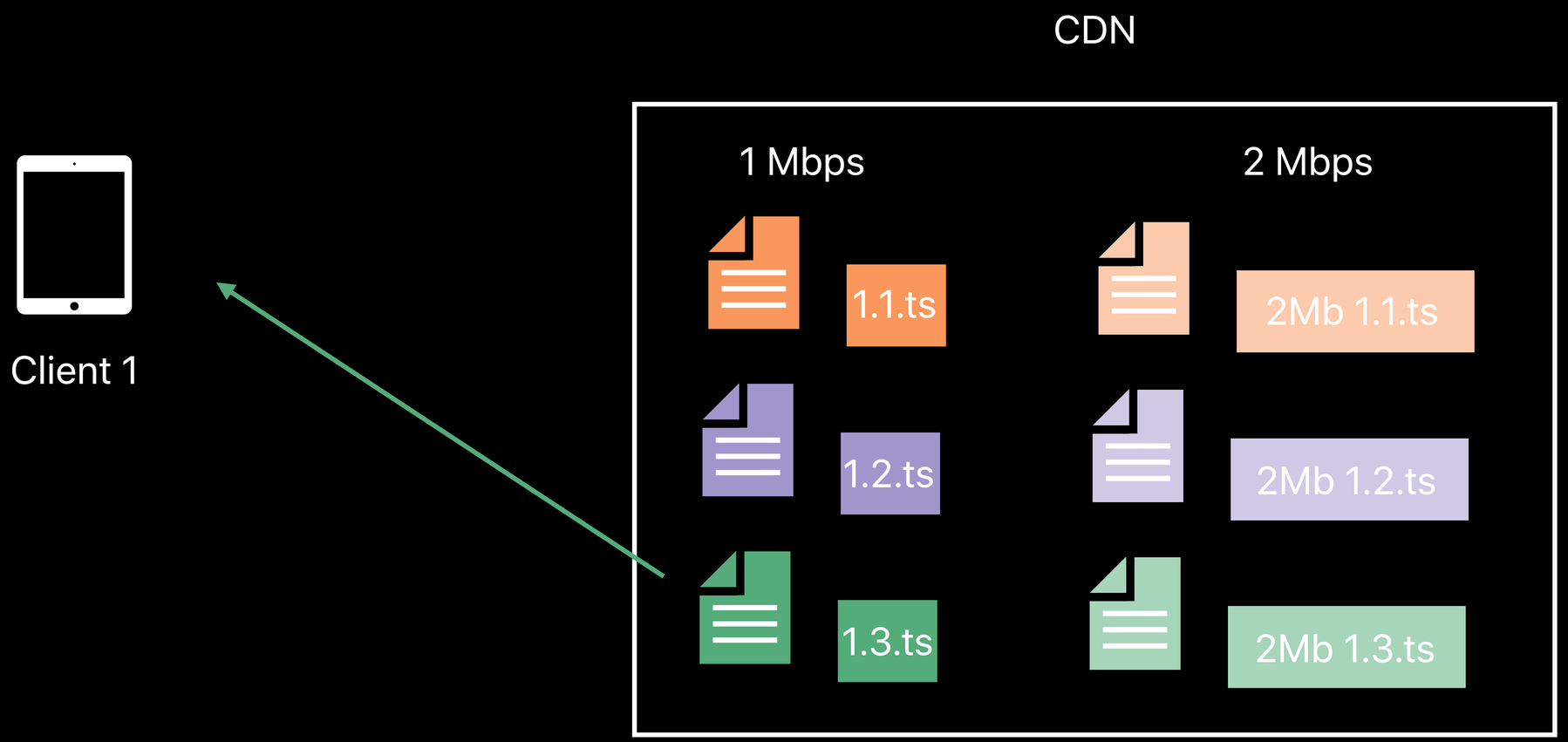

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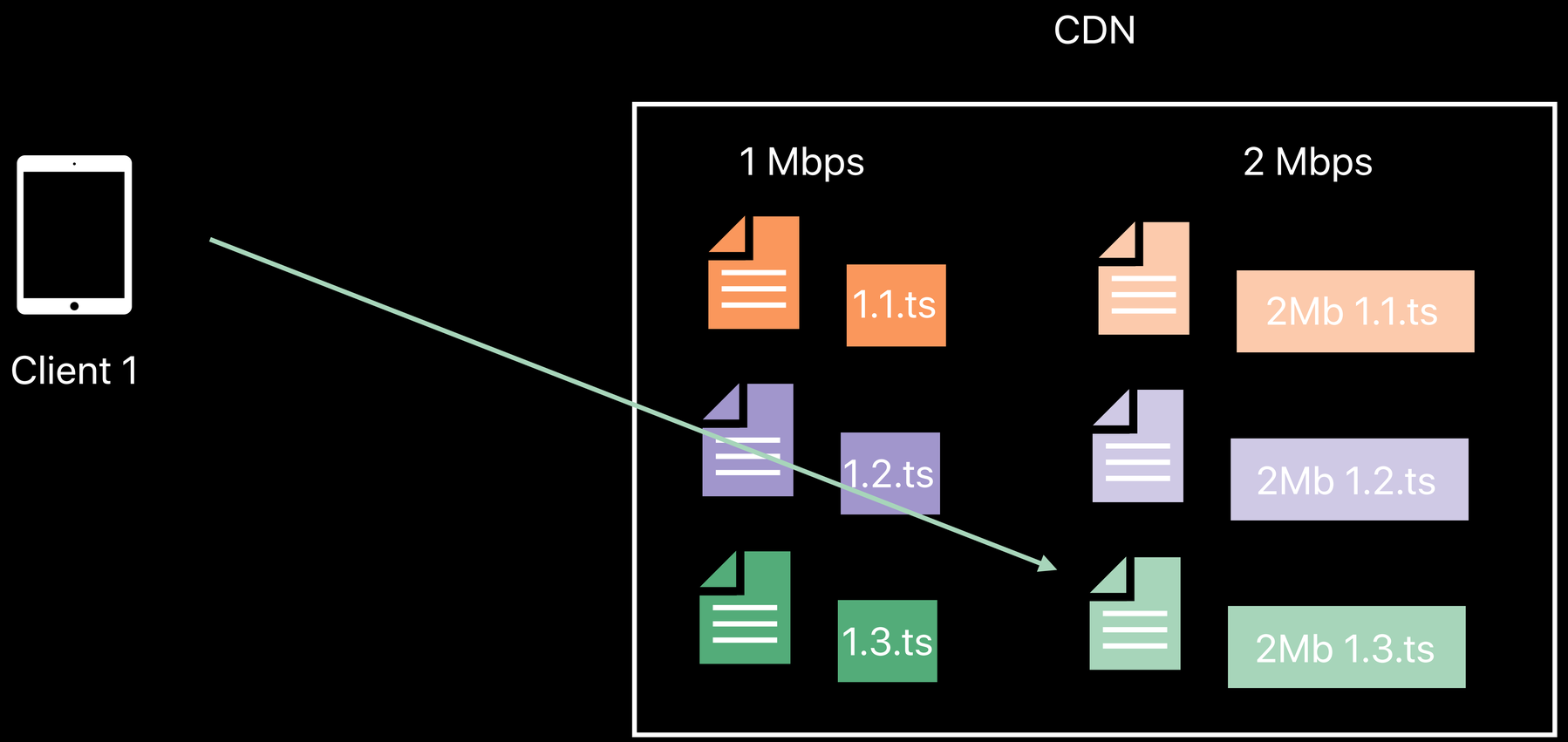

Reduce Publishing Latency

Optimize Discovery

Eliminate Round Trips

Reduce Transfer Overhead

Switch Tiers Quickly

The Details

Origin API

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Enabled by EXT-X-SERVER-CONTROL

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Small number of server directives

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Enabled by EXT-X-SERVER-CONTROL

Small number of server directives

Carried as query parameters on Playlist URL

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Enabled by EXT-X-SERVER-CONTROL

Small number of server directives

Carried as query parameters on Playlist URL

```
GET https://example.com/live.m3u8?_HLS_skip=YES
```

Origin API

Enabled by EXT-X-SERVER-CONTROL

Small number of server directives

Carried as query parameters on Playlist URL

```
GET https://example.com/live.m3u8?_HLS_skip=YES
```

_HLS* parameters are reserved on m3u8 URLs

Origin API

Enabled by EXT-X-SERVER-CONTROL

Small number of server directives

Carried as query parameters on Playlist URL

```
GET https://example.com/live.m3u8?_HLS_skip=YES
```

_HLS* parameters are reserved on m3u8 URLs

Sorted within URL to improve CDN hit ratio

Partial Segments

Reduce Publishing Latency

Partial Segments

Reduce Publishing Latency

Partial Segment is a subset of a regular Segment

Partial Segments

Reduce Publishing Latency

Partial Segment is a subset of a regular Segment

- CMAF Chunks, or short TS, audio or VTT

Partial Segments

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- CMAF Chunks, or short TS, audio or VTT
- Less than a full GOP

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Playlists update every Partial Segment

Partial Segments

Reduce Publishing Latency

Partial Segment is a subset of a regular Segment

- CMAF Chunks, or short TS, audio or VTT
- Less than a full GOP

Playlists update every Partial Segment

Publishing latency becomes the Partial Segment duration

Partial Segments

Reduce Publishing Latency

Partial Segment is a subset of a regular Segment

- CMAF Chunks, or short TS, audio or VTT
- Less than a full GOP

Playlists update every Partial Segment

Publishing latency becomes the Partial Segment duration

Partial Segments appear in parallel to regular Segments in Playlist

Partial Segments Disappear Quickly

Reduce Publishing Latency

Partial Segments Disappear Quickly

Reduce Publishing Latency

Partial Segments only at live edge of Playlist

Partial Segments Disappear Quickly

Reduce Publishing Latency

Partial Segments only at live edge of Playlist

- Removed once Parent Segments are established

Partial Segments Disappear Quickly

Reduce Publishing Latency

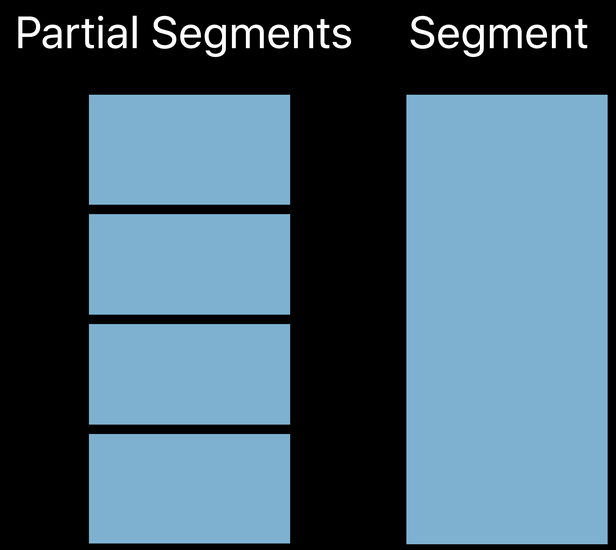
Partial Segments only at live edge of Playlist

- Removed once Parent Segments are established
- Keeps Playlists small

Partial Segments Disappear Quickly

Partial Segments only at live edge of Playlist

- Removed once Parent Segments are established
- Keeps Playlists small

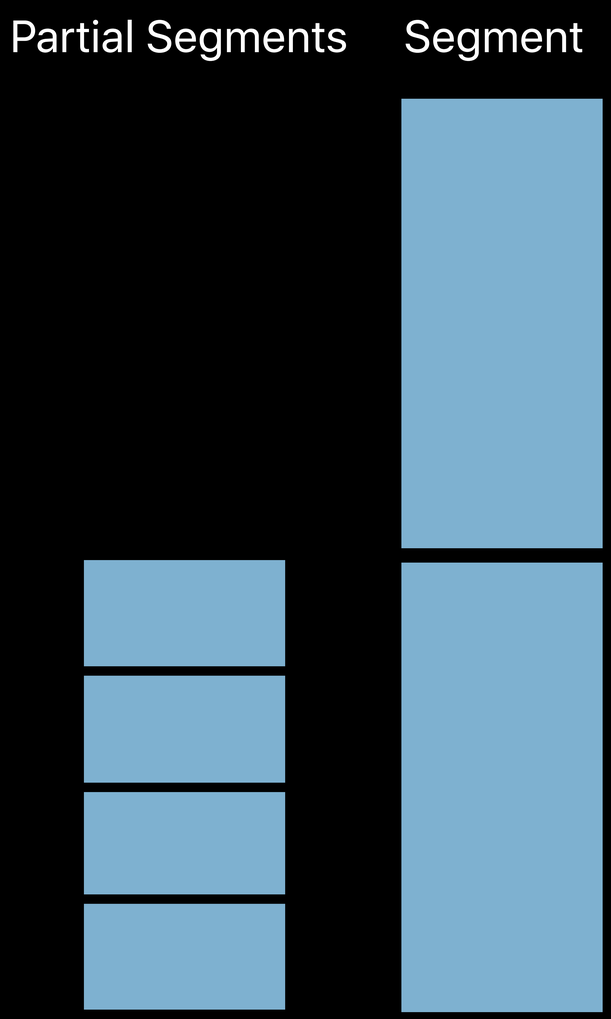


Partial Segments Disappear Quickly

Reduce Publishing Latency

Partial Segments only at live edge of Playlist

- Removed once Parent Segments are established
- Keeps Playlists small



Reduce Publishing Latency

```
# The new EXT-X-PART Tag
#EXTM3U
#EXT-X-TARGETDURATION:6.0
#EXT-X-PART-INF:PART-TARGET=0.5
#EXTINF 6.0,
segment43.ts
```

Reduce Publishing Latency

```
# The new EXT-X-PART Tag
#EXTM3U
#EXT-X-TARGETDURATION:6.0
#EXT-X-PART-INF:PART-TARGET=0.5
#EXTINF 6.0,
segment43.ts
#EXT-X-PART:URI="segment44.1.ts",DURATION=0.5,INDEPENDENT=YES
```

Reduce Publishing Latency

```
# The new EXT-X-PART Tag
#EXTM3U
#EXT-X-TARGETDURATION:6.0
#EXT-X-PART-INF:PART-TARGET=0.5
#EXTINF 6.0,
segment43.ts
#EXT-X-PART:URI="segment44.1.ts",DURATION=0.5,INDEPENDENT=YES
#EXT-X-PART:URI="segment44.2.ts",DURATION=0.5
```

Reduce Publishing Latency

```
# The new EXT-X-PART Tag
#EXTM3U
#EXT-X-TARGETDURATION:6.0
#EXT-X-PART-INF:PART-TARGET=0.5
#EXTINF 6.0,
segment43.ts
#EXT-X-PART:URI="segment44.1.ts",DURATION=0.5,INDEPENDENT=YES
#EXT-X-PART:URI="segment44.2.ts",DURATION=0.5
 ⋮
```

Reduce Publishing Latency

```
# The new EXT-X-PART Tag
#EXTM3U
#EXT-X-TARGETDURATION:6.0
#EXT-X-PART-INF:PART-TARGET=0.5
#EXTINF 6.0,
segment43.ts
#EXT-X-PART:URI="segment44.1.ts",DURATION=0.5,INDEPENDENT=YES
#EXT-X-PART:URI="segment44.2.ts",DURATION=0.5
 ⋮
#EXT-X-PART:URI="segment44.12.ts",DURATION=0.5
#EXTINF 6.0,
segment44.ts
```

Reduce Publishing Latency

```
# The new EXT-X-PART Tag
#EXTM3U
#EXT-X-TARGETDURATION:6.0
#EXT-X-PART-INF:PART-TARGET=0.5
#EXTINF 6.0,
segment43.ts
#EXT-X-PART:URI="segment44.1.ts",DURATION=0.5,INDEPENDENT=YES
#EXT-X-PART:URI="segment44.2.ts",DURATION=0.5
 ⋮
#EXT-X-PART:URI="segment44.12.ts",DURATION=0.5
#EXTINF 6.0,
segment44.ts
#EXT-X-PART:URI="segment45.1.ts",DURATION=0.5,INDEPENDENT=YES
```

Reduce Publishing Latency

```
# The new EXT-X-PART Tag
#EXTM3U
#EXT-X-TARGETDURATION:6.0
#EXT-X-PART-INF:PART-TARGET=0.5
#EXTINF 6.0,
segment43.ts
#EXT-X-PART:URI="segment44.1.ts",DURATION=0.5,INDEPENDENT=YES
#EXT-X-PART:URI="segment44.2.ts",DURATION=0.5
 ⋮
#EXT-X-PART:URI="segment44.12.ts",DURATION=0.5
#EXTINF 6.0,
segment44.ts
#EXT-X-PART:URI="segment45.1.ts",DURATION=0.5,INDEPENDENT=YES
#EXT-X-PART:URI="segment45.2.ts",DURATION=0.5
 ⋮
#EXT-X-PART:URI=“segment45.12.ts",DURATION=0.5
#EXTINF 6.0,
segment45.ts
```

Reduce Publishing Latency

```
# The new EXT-X-PART Tag
#EXTM3U
#EXT-X-TARGETDURATION:6.0
#EXT-X-PART-INF:PART-TARGET=0.5
#EXTINF 6.0,
segment43.ts
#EXTINF 6.0,
segment44.ts
#EXT-X-PART:URI="segment45.1.ts",DURATION=0.5,INDEPENDENT=YES
#EXT-X-PART:URI="segment45.2.ts",DURATION=0.5
 ⋮
#EXT-X-PART:URI=“segment45.12.ts",DURATION=0.5
#EXTINF 6.0,
segment45.ts
```

Blocking Playlist Reload

Blocking Playlist Reload

Optimize Discovery

EXT-X-SERVER-CONTROL with CAN-BLOCK-RELOAD attribute

Blocking Playlist Reload

EXT-X-SERVER-CONTROL with CAN-BLOCK-RELOAD attribute

Clients ask for its next Playlist update in advance

Blocking Playlist Reload

EXT-X-SERVER-CONTROL with CAN-BLOCK-RELOAD attribute

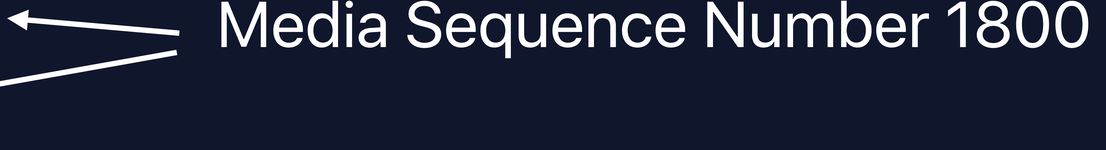
Clients ask for its next Playlist update in advance

Server holds request until next Segment or Partial Segment appears

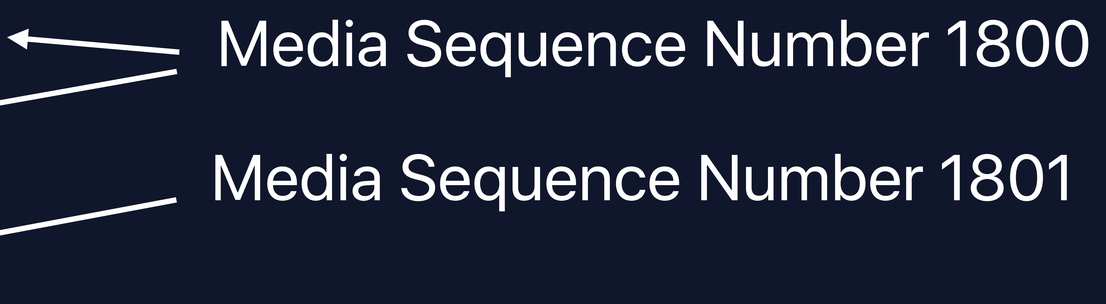
Optimize Discovery

```
#EXTM3U
#EXT-X-TARGETDURATION:6
#EXT-X-MEDIA-SEQUENCE:1800
#EXTINF 6.0,
segment-abc.ts
#EXTINF 6.0,
segment-def.ts
#EXT-X-DISCONTINUITY
#EXTINF 6.0,
ad-xyz.ts
```

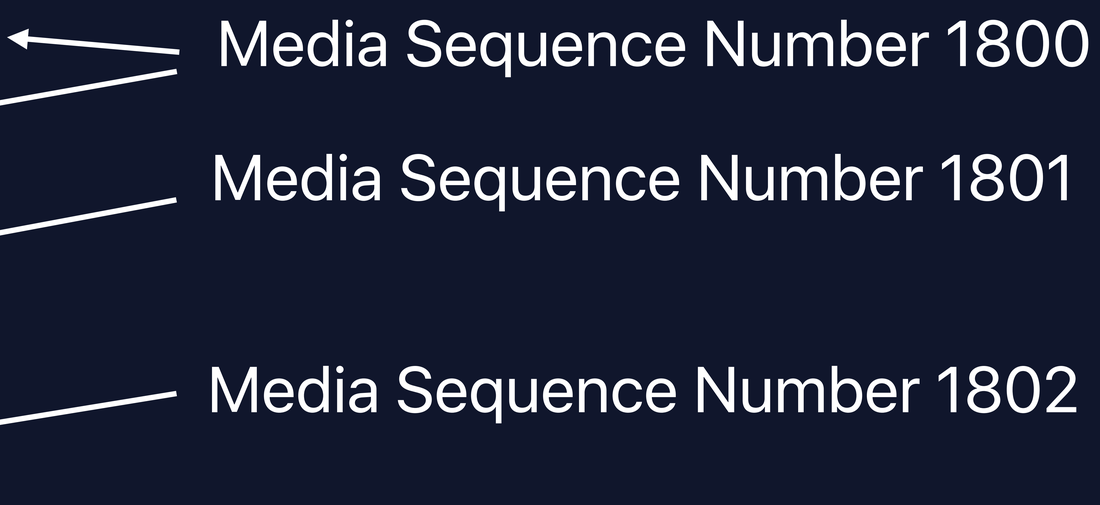
```
#EXTM3U
#EXT-X-TARGETDURATION:6
#EXT-X-MEDIA-SEQUENCE:1800
#EXTINF 6.0,
segment-abc.ts
#EXTINF 6.0,
segment-def.ts
#EXT-X-DISCONTINUITY
#EXTINF 6.0,
ad-xyz.ts
```

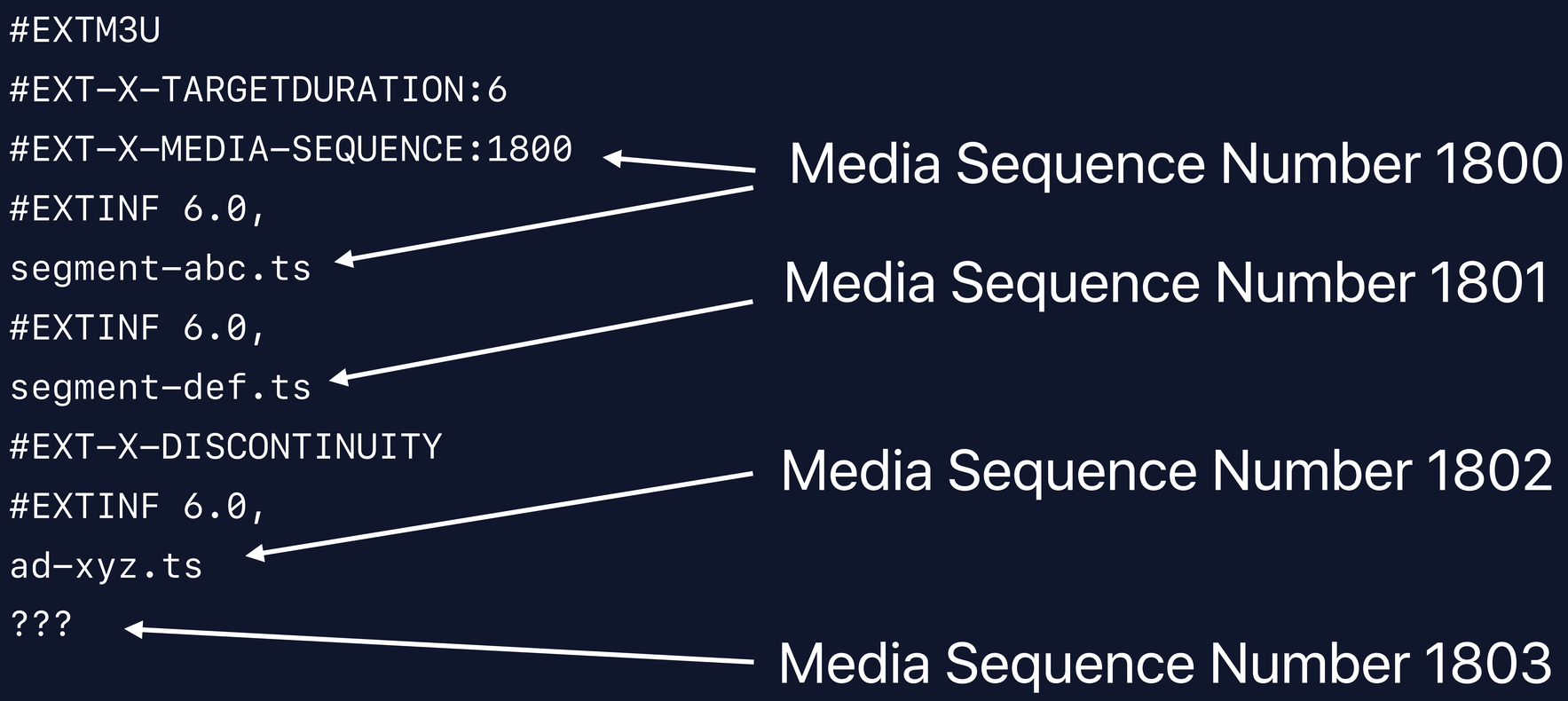


```
#EXTM3U
#EXT-X-TARGETDURATION:6
#EXT-X-MEDIA-SEQUENCE:1800
#EXTINF 6.0,
segment-abc.ts
#EXTINF 6.0,
segment-def.ts
#EXT-X-DISCONTINUITY
#EXTINF 6.0,
ad-xyz.ts
```



```
#EXTM3U
#EXT-X-TARGETDURATION:6
#EXT-X-MEDIA-SEQUENCE:1800
#EXTINF 6.0,
segment-abc.ts
#EXTINF 6.0,
segment-def.ts
#EXT-X-DISCONTINUITY
#EXTINF 6.0,
ad-xyz.ts
```




#EXTM3U
#EXT-X-TARGETDURATION:6
#EXT-X-MEDIA-SEQUENCE:1800
#EXTINF 6.0,
segment-abc.ts
#EXTINF 6.0,
segment-def.ts
#EXT-X-DISCONTINUITY
#EXTINF 6.0,
ad-xyz.ts
???
Media Sequence Number 1800
Media Sequence Number 1801
Media Sequence Number 1802
Media Sequence Number 1803

Optimize Discovery

Optimize Discovery

```
# Blocking Playlist Reload
# Block until Media Sequence Number 1803 is in Playlist

GET https://example.com/live.m3u8?_HLS_msn=1803
```

Optimize Discovery

```
# Blocking Playlist Reload
# Block until Media Sequence Number 1803 is in Playlist

GET https://example.com/live.m3u8?_HLS_msn=1803


# Block until first part of Media Sequence Number 1803 is in Playlist

GET https://example.com/live.m3u8?_HLS_msn=1803&_HLS_part=0&_HLS_push=1
```

```
# Blocking Playlist Reload
# Block until Media Sequence Number 1803 is in Playlist

GET https://example.com/live.m3u8?_HLS_msn=1803


# Block until first part of Media Sequence Number 1803 is in Playlist

GET https://example.com/live.m3u8?_HLS_msn=1803&_HLS_part=0&_HLS_push=1
```

Optimize Discovery

```
# Blocking Playlist Reload
# Block until Media Sequence Number 1803 is in Playlist

GET https://example.com/live.m3u8?_HLS_msn=1803


# Block until first part of Media Sequence Number 1803 is in Playlist

GET https://example.com/live.m3u8?_HLS_msn=1803&_HLS_part=0&_HLS_push=1
```

HTTP/2

Eliminate Round Trips

HTTP/2

Eliminate Round Trips

Successor to HTTP 1.1

HTTP/2

Eliminate Round Trips

Successor to HTTP 1.1

RFC 7540 published in 2015

HTTP/2

Eliminate Round Trips

Successor to HTTP 1.1

RFC 7540 published in 2015

Widely supported

HTTP/2

Eliminate Round Trips

Successor to HTTP 1.1

RFC 7540 published in 2015

Widely supported

Required for Low Latency HLS

HTTP/2

Eliminate Round Trips

Successor to HTTP 1.1

RFC 7540 published in 2015

Widely supported

Required for Low Latency HLS

HTTP/2 Push

HTTP/2

Eliminate Round Trips

Successor to HTTP 1.1

RFC 7540 published in 2015

Widely supported

Required for Low Latency HLS

HTTP/2 Push

- GET response can include secondary resources

Segment Push

Eliminate Round Trips

Segment Push

Eliminate Round Trips

GET of Playlist also pushes new Segment

Segment Push

Eliminate Round Trips

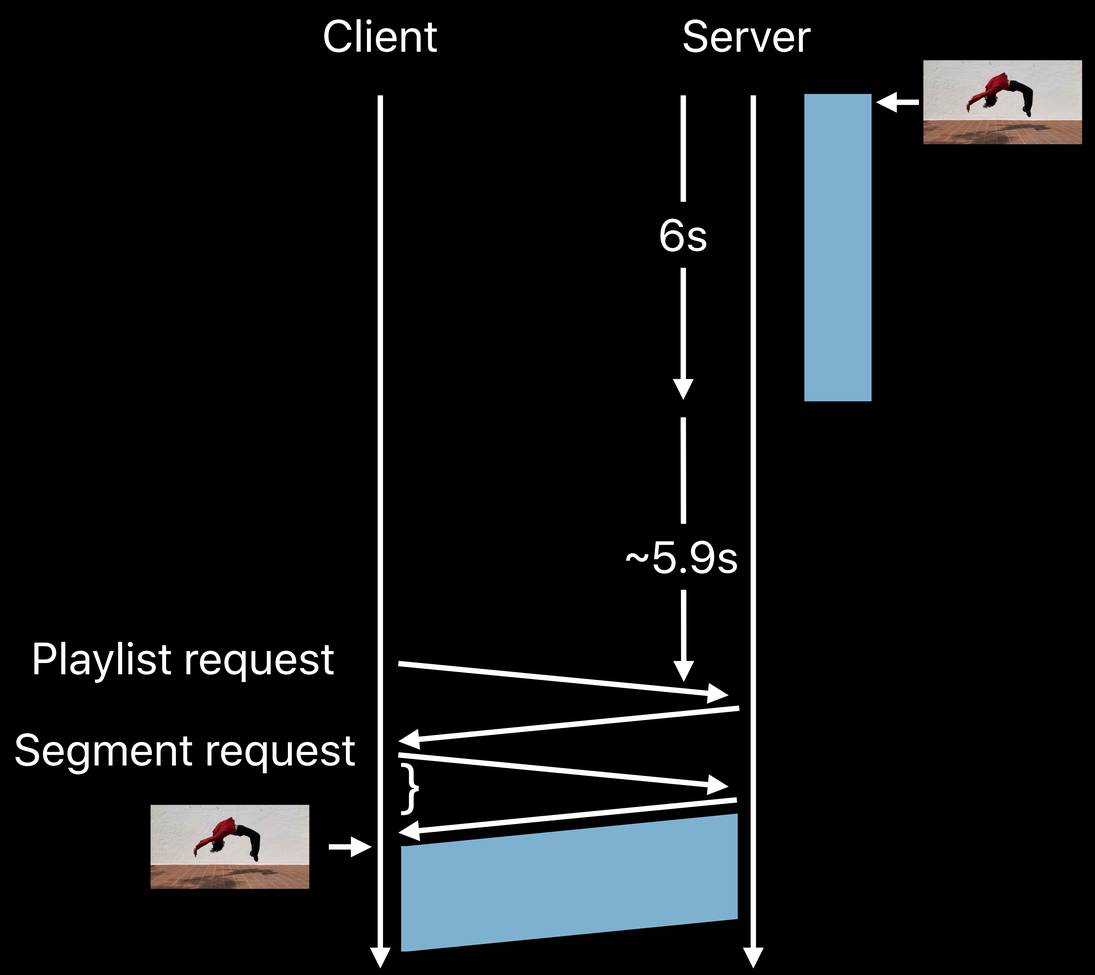
GET of Playlist also pushes new Segment

- Eliminates round trip request

Reduce Publishing Latency

Optimize Discovery

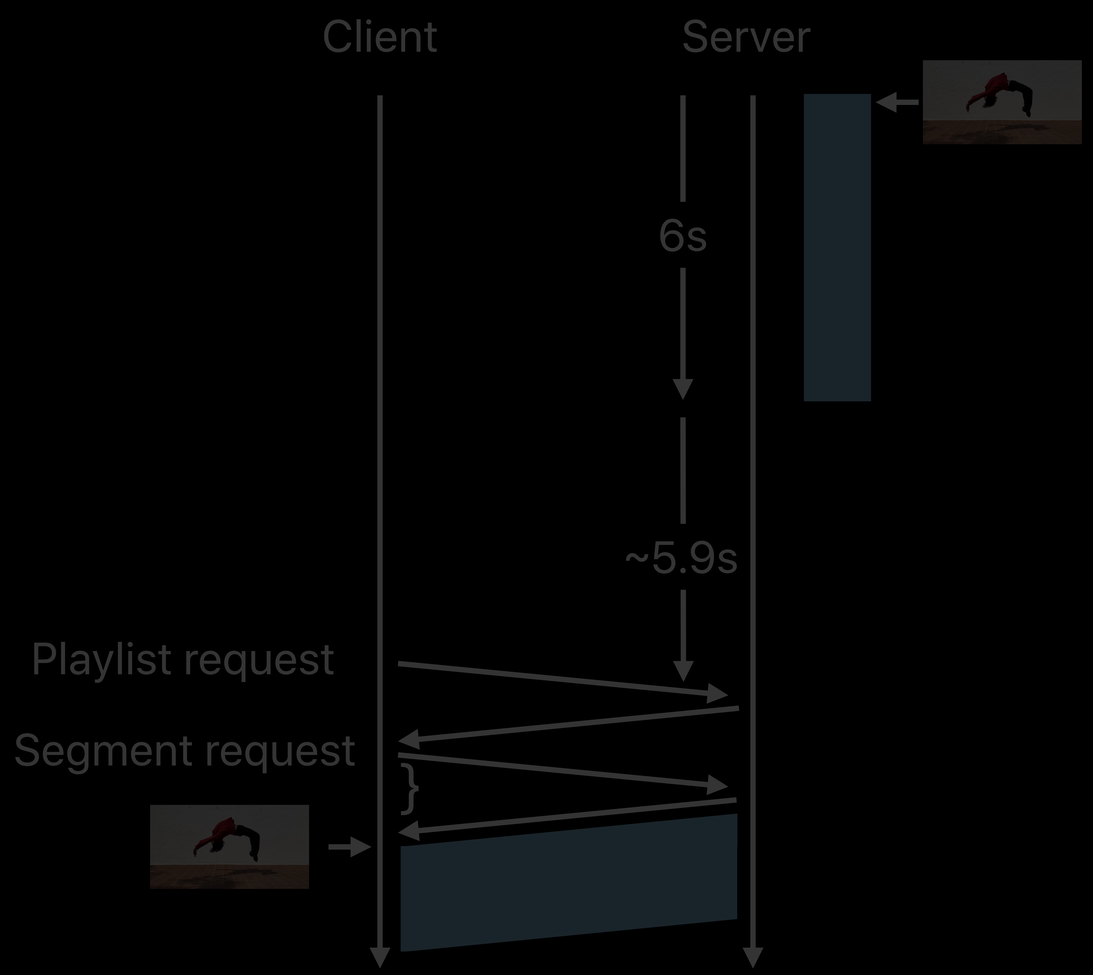
Eliminate Round Trips

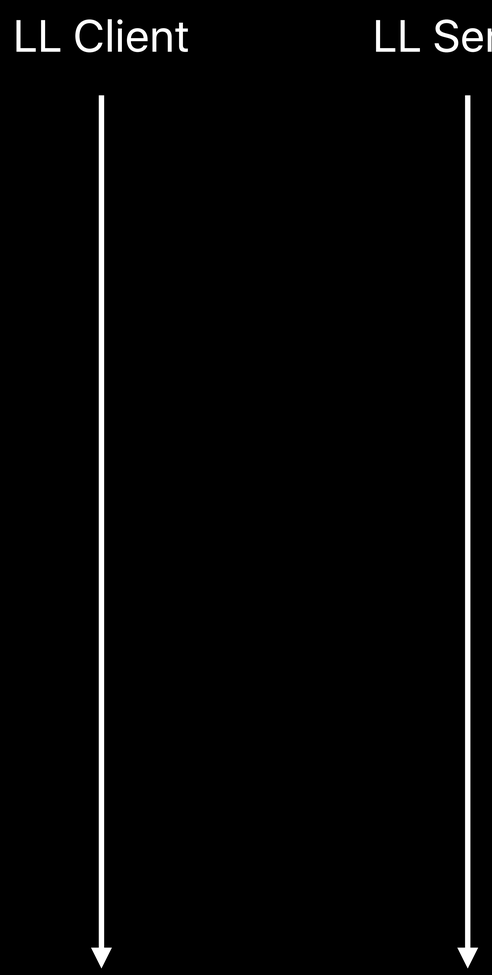


Reduce Publishing Latency

Optimize Discovery

Eliminate Round Trips

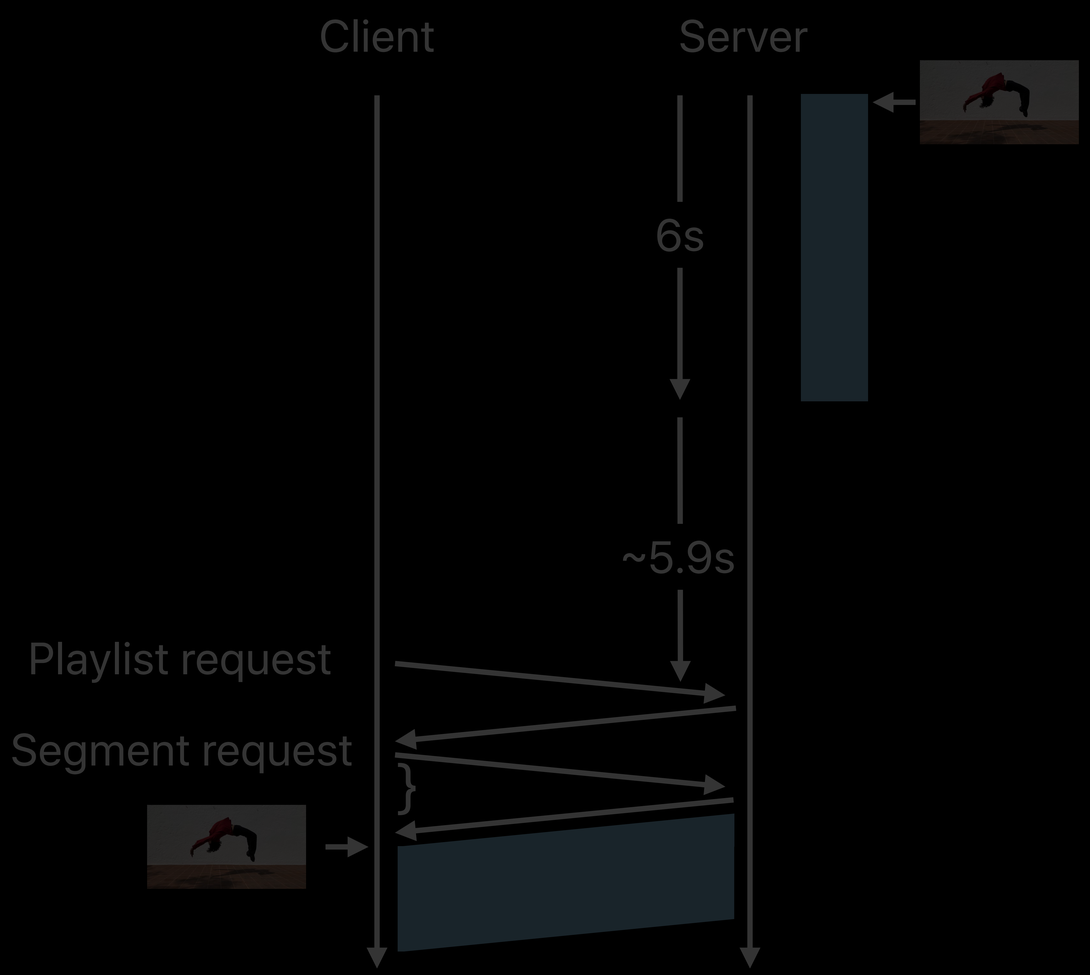


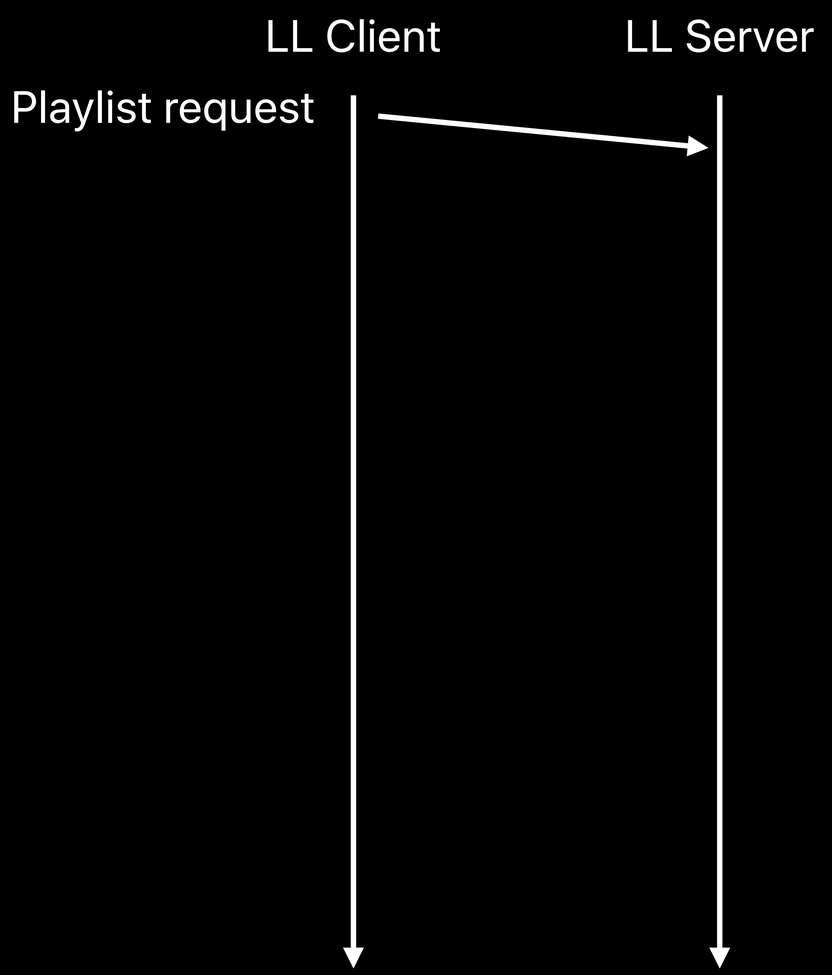


Reduce Publishing Latency

Optimize Discovery

Eliminate Round Trips

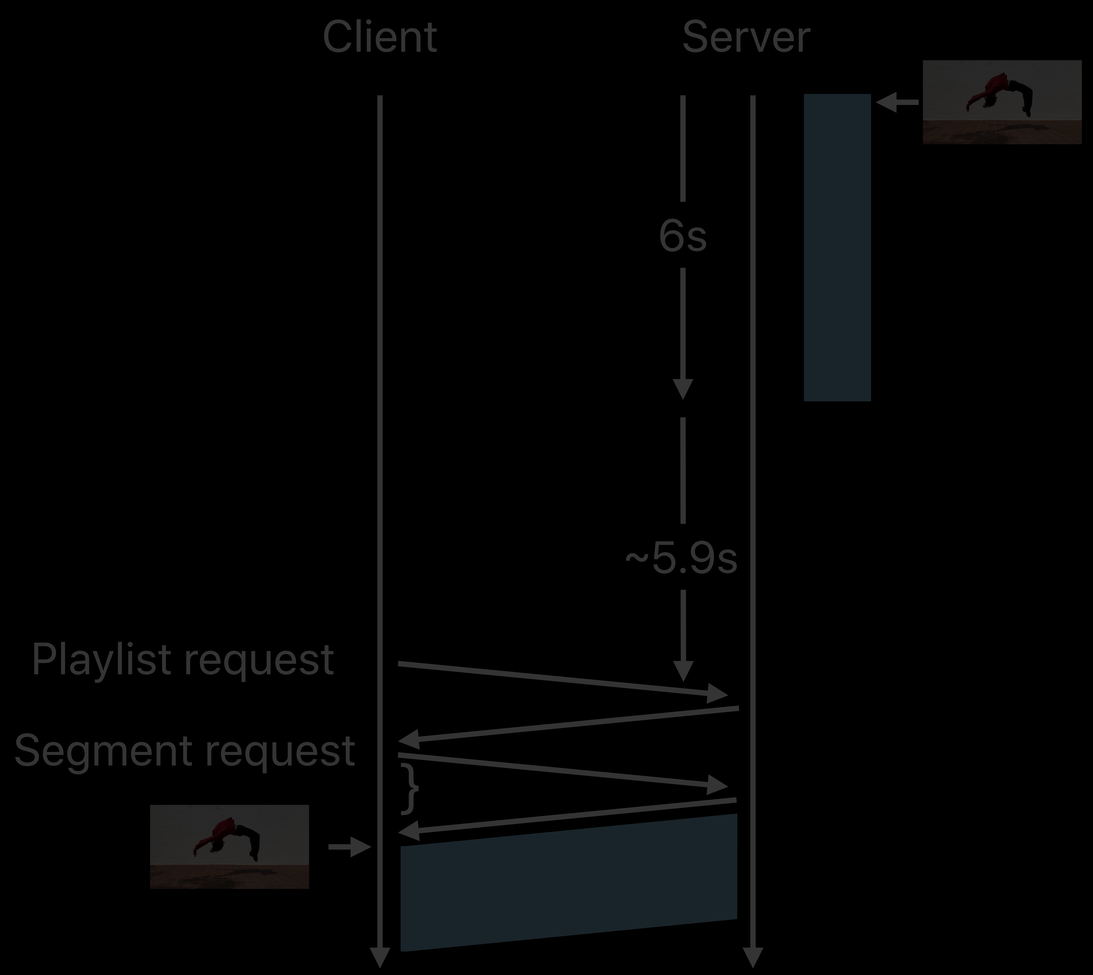


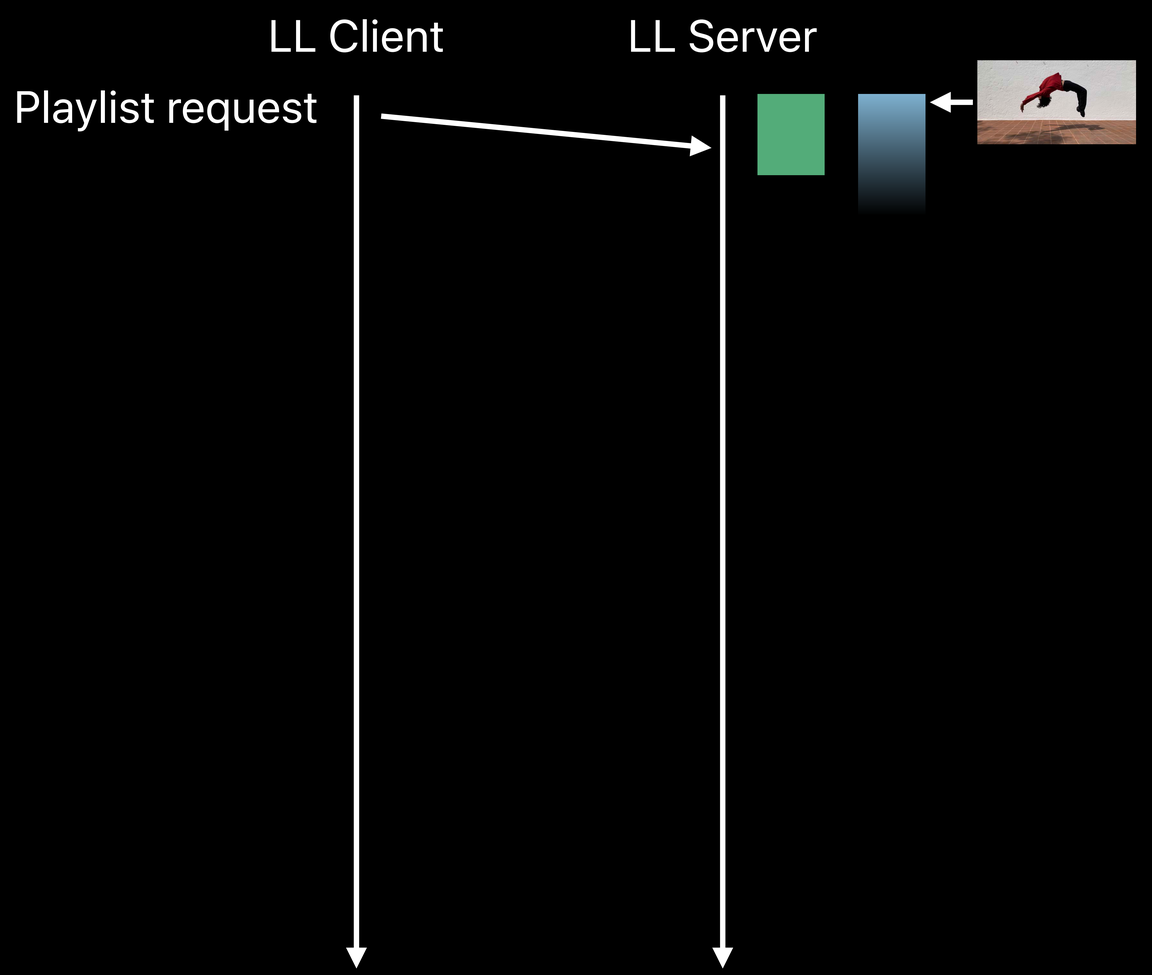


Reduce Publishing Latency

Optimize Discovery

Eliminate Round Trips

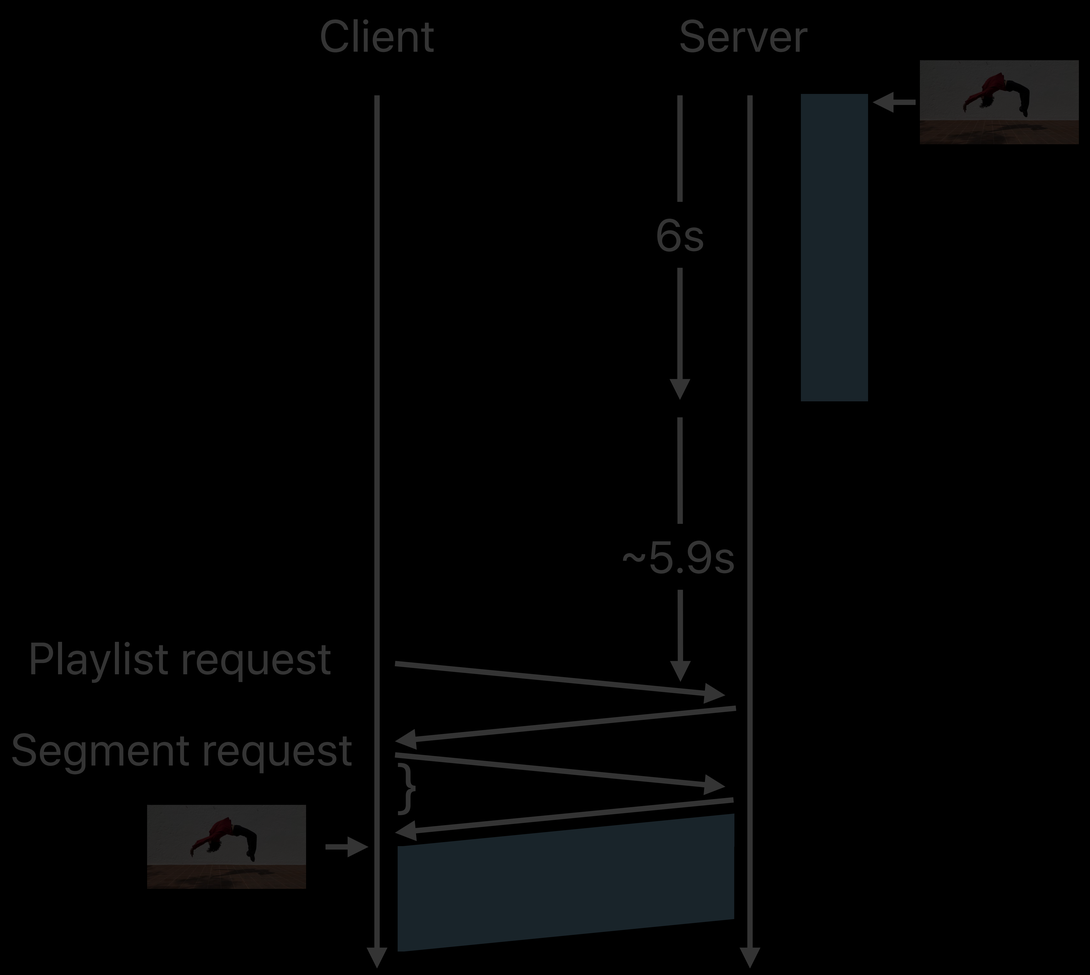


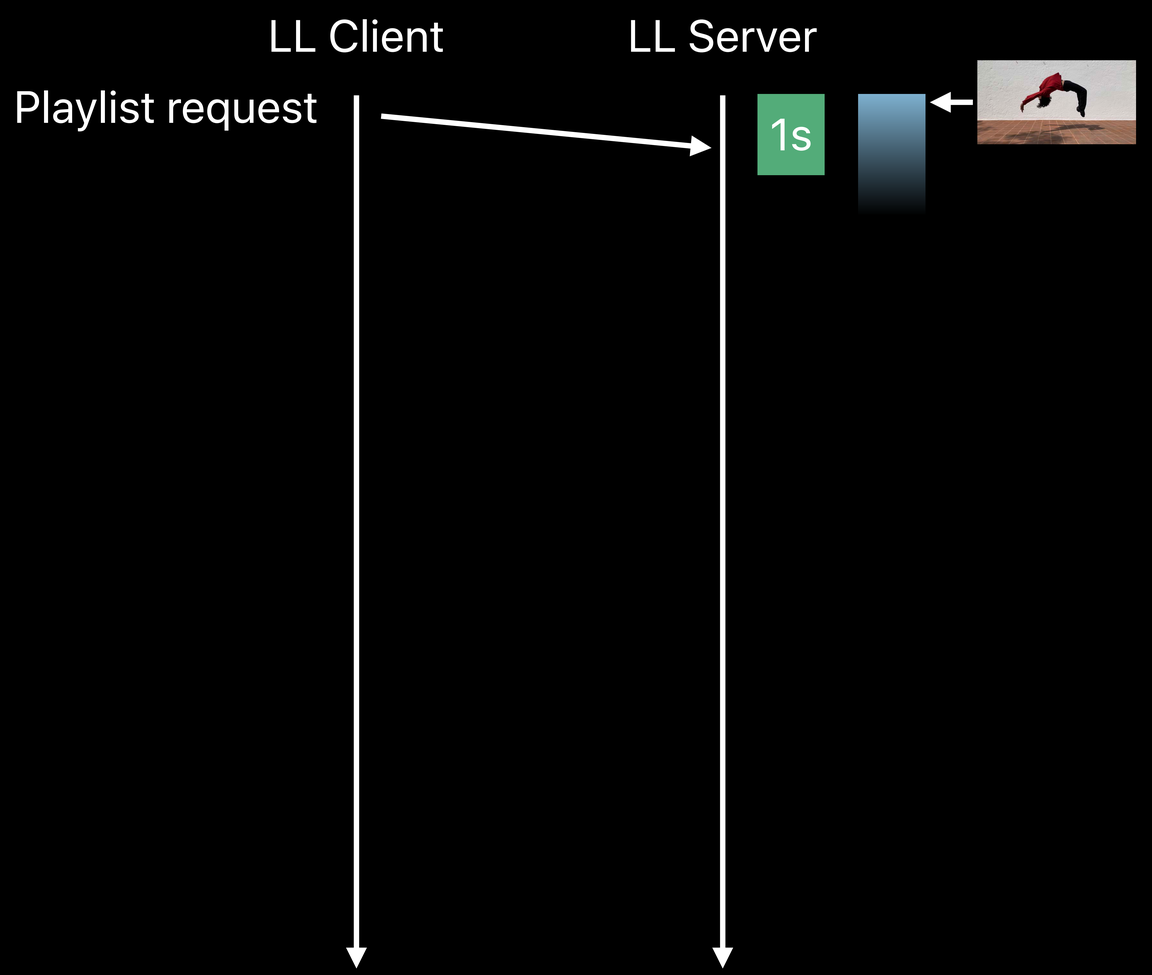


Reduce Publishing Latency

Optimize Discovery

Eliminate Round Trips

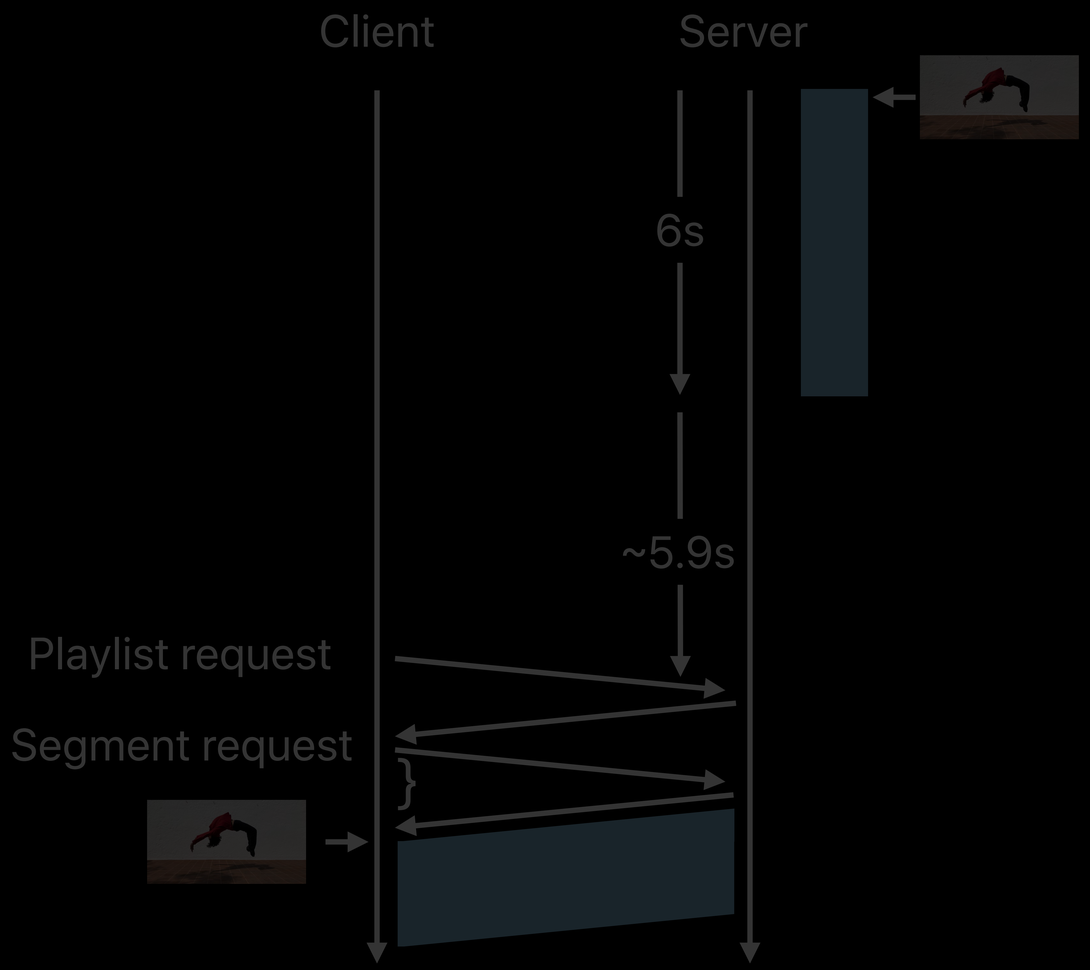


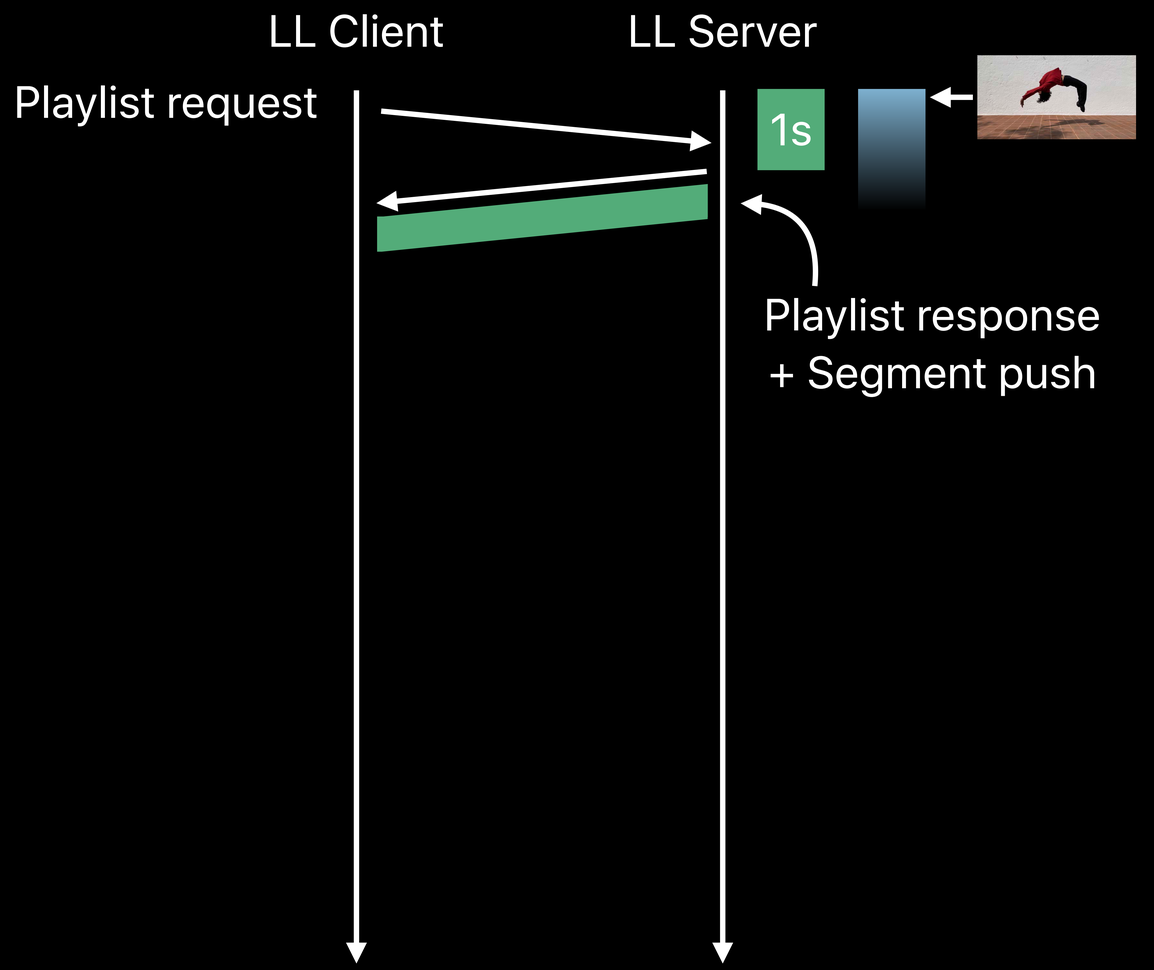


Reduce Publishing Latency

Optimize Discovery

Eliminate Round Trips





Reduce Publishing Latency

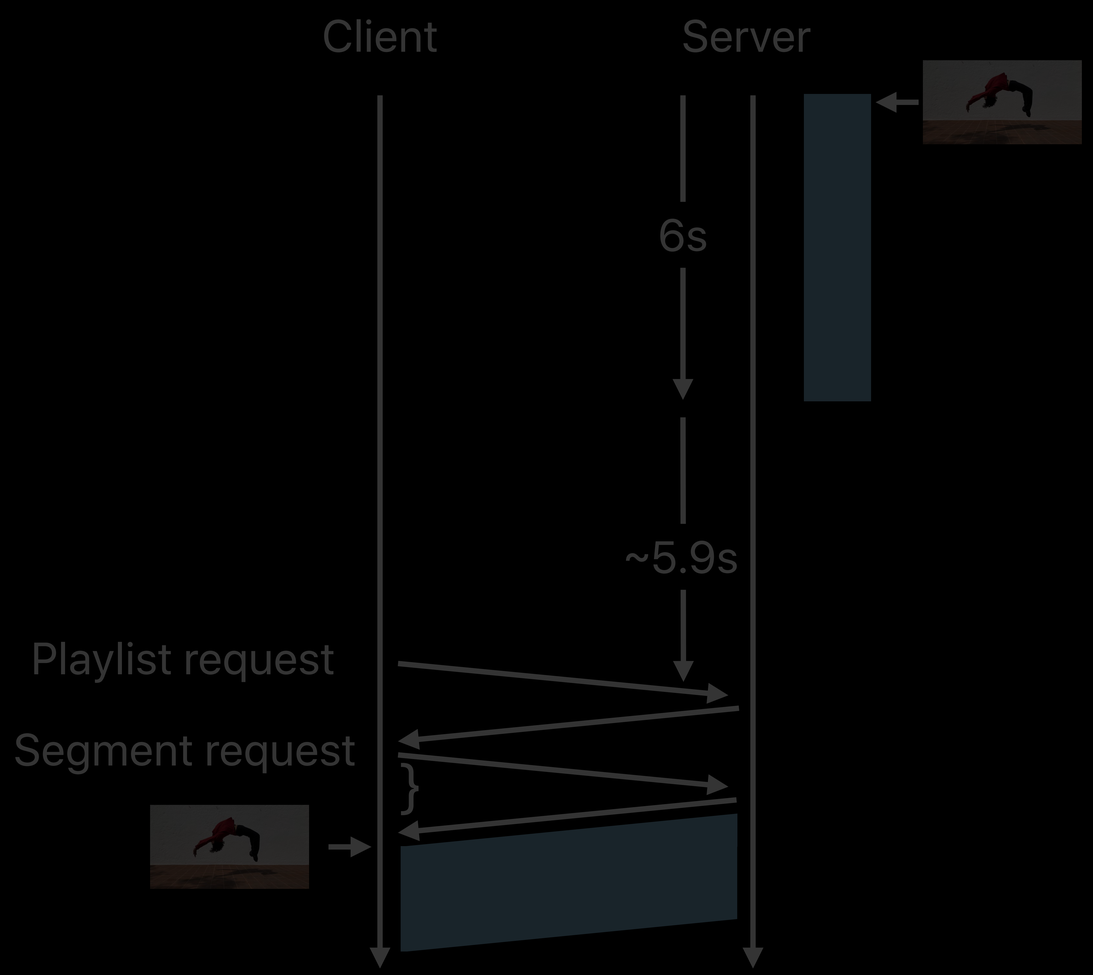
Optimize Discovery

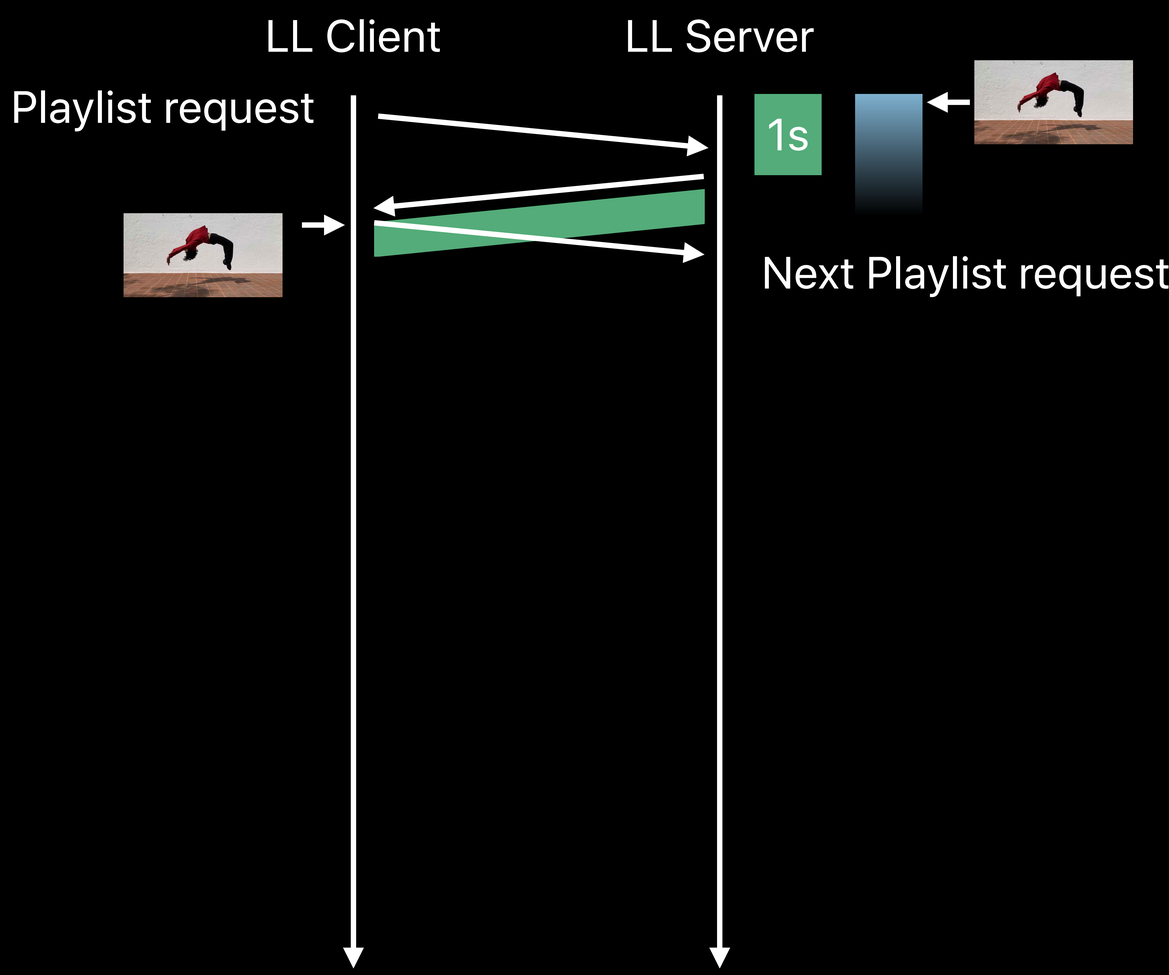
Eliminate Round Trips

Reduce Publishing Latency

Optimize Discovery

Eliminate Round Trips





Playlist Delta Updates

Reduce Transfer Overhead

Playlist Delta Updates

Reduce Transfer Overhead

EXT-X-SERVER-CONTROL with CAN-SKIP-UNTIL attribute

Playlist Delta Updates

Reduce Transfer Overhead

EXT-X-SERVER-CONTROL with CAN-SKIP-UNTIL attribute

Clients asks for Delta Update explicitly

Playlist Delta Updates

Reduce Transfer Overhead

EXT-X-SERVER-CONTROL with CAN-SKIP-UNTIL attribute

Clients asks for Delta Update explicitly

Update skips the earlier part of Playlist client already has

Reduce Transfer Overhead

The new EXT-X-SKIP Tag

GET https://example.com/1M/live.m3u8?_HLS_skip=YES

```
#EXTM3U
#EXT-X-VERSION:9
#EXT-X-SERVER-CONTROL:CAN-SKIP-UNTIL=36.0
#EXT-X-TARGETDURATION:6
#EXT-X-MEDIA-SEQUENCE:100
#EXT-X-SKIP:SKIPPED-SEGMENTS=1700
#EXTINF 6.0,
segment1800.ts
#EXTINF 6.0,
segment1801.ts
#EXTINF 6.0,
segment1802.ts
...
```

Reduce Transfer Overhead

The new EXT-X-SKIP Tag

GET https://example.com/1M/live.m3u8?_HLS_skip=YES

```
#EXTM3U
#EXT-X-VERSION:9
#EXT-X-SERVER-CONTROL:CAN-SKIP-UNTIL=36.0
#EXT-X-TARGETDURATION:6
#EXT-X-MEDIA-SEQUENCE:100
#EXT-X-SKIP:SKIPPED-SEGMENTS=1700
#EXTINF 6.0,
segment1800.ts
#EXTINF 6.0,
segment1801.ts
#EXTINF 6.0,
segment1802.ts
...
```

Reduce Transfer Overhead

The new EXT-X-SKIP Tag

GET https://example.com/1M/live.m3u8?_HLS_skip=YES

```
#EXTM3U
#EXT-X-VERSION:9
#EXT-X-SERVER-CONTROL:CAN-SKIP-UNTIL=36.0
#EXT-X-TARGETDURATION:6
#EXT-X-MEDIA-SEQUENCE:100
#EXT-X-SKIP:SKIPPED-SEGMENTS=1700
#EXTINF 6.0,
segment1800.ts
#EXTINF 6.0,
segment1801.ts
#EXTINF 6.0,
segment1802.ts
...
```

Rendition Reports

Switch Tiers Quickly

Rendition Reports

Switch Tiers Quickly

Playlist updates can carry up-to-date reports on peer Playlists

Rendition Reports

Switch Tiers Quickly

Playlist updates can carry up-to-date reports on peer Playlists

- Last Media Sequence Number and last Partial Segment number

Rendition Reports

Switch Tiers Quickly

Playlist updates can carry up-to-date reports on peer Playlists

- Last Media Sequence Number and last Partial Segment number
- Allows client to load latest Playlist when switching bit rates

```
# Requesting and receiving Rendition Reports

GET https://example.com/1M/live.m3u8?_HLS_report=/2M/live.m3u8
```

Requesting and receiving Rendition Reports

```
GET https://example.com/1M/live.m3u8?_HLS_report=/2M/live.m3u8

#EXTM3U
#EXT-X-RENDITION-REPORT:URI="/2M/live.m3u8",LAST-MSN=1801,LAST-PART=0
#EXT-X-TARGETDURATION:6
#EXT-X-MEDIA-SEQUENCE:1800
#EXTINF 6.0,
segment73.ts
...
```

Putting It All Together


NORTH
AMERICA
San Jose
NORTH PACIFIC OCEAN


NORTH
AMERICA
San Jose
NORTH PACIFIC OCEAN

Demo

How To Get Started

App Adoption

```
// Discover and adjust distance from live

var item = myAVPlayerItem()
var howFarNow = item.configuredTimeOffsetFromLive
```

```
// Discover and adjust distance from live

var item = myAVPlayerItem()
var howFarNow = item.configuredTimeOffsetFromLive
```

```
// Discover and adjust distance from live

var item = myAVPlayerItem()
var howFarNow = item.configuredTimeOffsetFromLive
var recommended = item.recommendedTimeOffsetFromLive
```

```
// Discover and adjust distance from live

var item = myAVPlayerItem()
var howFarNow = item.configuredTimeOffsetFromLive
var recommended = item.recommendedTimeOffsetFromLive

if ( howFarNow < recommended ) {
    item.configuredTimeOffsetFromLive = recommended
}
```

```
// Discover and adjust distance from live

var item = myAVPlayerItem()
var howFarNow = item.configuredTimeOffsetFromLive
var recommended = item.recommendedTimeOffsetFromLive

if ( howFarNow < recommended ) {
    item.configuredTimeOffsetFromLive = recommended
}

// Maintain position of playhead relative to live edge after rebuffer
item.automaticallyPreservesTimeOffsetFromLive = YES
```

```
// Discover and adjust distance from live

var item = myAVPlayerItem()
var howFarNow = item.configuredTimeOffsetFromLive
var recommended = item.recommendedTimeOffsetFromLive

if ( howFarNow < recommended ) {
    item.configuredTimeOffsetFromLive = recommended
}

// Maintain position of playhead relative to live edge after rebuffer
item.automaticallyPreservesTimeOffsetFromLive = YES
```

Configure Your CDN

Configure Your CDN

Deliver HLS via HTTP/2

Configure Your CDN

Deliver HLS via HTTP/2

- Support HTTP/2 Push

Configure Your CDN

Deliver HLS via HTTP/2

- Support HTTP/2 Push
- Support HTTP/2 dependency and weighting

Configure Your CDN

Deliver HLS via HTTP/2

- Support HTTP/2 Push
- Support HTTP/2 dependency and weighting

Each server must vend all bit rate tiers

Configure Your CDN

Deliver HLS via HTTP/2

- Support HTTP/2 Push
- Support HTTP/2 dependency and weighting

Each server must vend all bit rate tiers

CDN must aggregate duplicate pending requests to origin

Configure Your CDN

Deliver HLS via HTTP/2

- Support HTTP/2 Push
- Support HTTP/2 dependency and weighting

Each server must vend all bit rate tiers

CDN must aggregate duplicate pending requests to origin

- "Reader while writer" in Apache Traffic Server

Implement Your Origin

Implement Your Origin

Spec for Low-Latency HLS is available today

Implement Your Origin

Spec for Low-Latency HLS is available today

- Currently a separate draft

Implement Your Origin

Spec for Low-Latency HLS is available today

- Currently a separate draft
- Will be merged into core HLS spec later this year

Implement Your Origin

Spec for Low-Latency HLS is available today

- Currently a separate draft
- Will be merged into core HLS spec later this year

Server Configuration Profile

Implement Your Origin

Spec for Low-Latency HLS is available today

- Currently a separate draft
- Will be merged into core HLS spec later this year

Server Configuration Profile

- Required features of Low-Latency servers

Reference Implementation

Reference Implementation

“Low-Latency HLS Beta Tools”

Reference Implementation

“Low-Latency HLS Beta Tools”

Create Playlists with Segments and Partial Segments

Reference Implementation

“Low-Latency HLS Beta Tools”

Create Playlists with Segments and Partial Segments

PHP front-end implements Origin API

Reference Implementation

“Low-Latency HLS Beta Tools”

Create Playlists with Segments and Partial Segments

PHP front-end implements Origin API

- Blocking Playlist Reload

Reference Implementation

“Low-Latency HLS Beta Tools”

Create Playlists with Segments and Partial Segments

PHP front-end implements Origin API

- Blocking Playlist Reload
- Playlist Delta Updates

Reference Implementation

“Low-Latency HLS Beta Tools”

Create Playlists with Segments and Partial Segments

PHP front-end implements Origin API

- Blocking Playlist Reload
- Playlist Delta Updates
- Rendition Reports

Beta in 2019

Beta in 2019

App entitlement `com.apple.developer.coremedia.hls.low-latency`

Beta in 2019

App entitlement `com.apple.developer.coremedia.hls.low-latency`

- Development

Beta in 2019

App entitlement `com.apple.developer.coremedia.hls.low-latency`

- Development
- TestFlight distribution

Summary

Summary

Read the spec

- https://developer.apple.com/documentation/http_live_streaming/protocol_extension_for_low_latency_hls

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Try out the beta

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Try out the beta

Build your packager and origin

More Information

developer.apple.com/wwdc19/502

HTTP Live Streaming Lab	Thursday, 4:00
HTTP Live Streaming Lab 2	Friday, 11:00


WWDC19